

City of Gresham

Public Works Standards



2006

Standard Details

Construction Specifications

Design Standards

EPSC Manual



PUBLIC WORKS STANDARDS

*Standard Detail Drawings
Construction Standard Specifications
Design Standards
Erosion Prevention & Sediment Control Manual*

January 1, 2006



***DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM, OREGON***

Approved:

A handwritten signature in black ink, appearing to be "D. Rouse", is written over a horizontal line.

*David S. Rouse
Director*

RESOLUTION NO. 2812

**A RESOLUTION ADOPTING PUBLIC WORKS STANDARDS AND REPEALING
RESOLUTION NO. 2456**

The City of Gresham Finds:

A. On April 3, 2001, by Resolution No. 2456, the City adopted Public Works Standards, containing three sections: Design Standards, Construction Specifications, and Standard Drawings.

B. On January 15, 2002, by Consent Agenda Item C-11, the City adopted the Erosion Prevention Sediment Control Manual as a part of the Public Works Standards.

C. The Public Work Standards have been reviewed and revised by City staff. Approximately 570 stakeholders throughout the community were notified of the proposed update of the PWS. These stakeholders included engineers, developers, suppliers, contractors, other public agencies and the representatives of the Development Advisory Group. All comments received were reviewed and addressed, with a majority of the comments being incorporated into the draft Public Work Standards.

THE CITY OF GRESHAM RESOLVES:

1. The Gresham City Council adopts the Public Works Standards, attached hereto as Exhibit A, containing four sections: Design Standards, Construction Specifications, Standard Drawings, and the Erosion Prevention Sediment Control Manual as the design and construction standards for all public and privately financed public works projects.

2. The Manager is authorized to update the Public Works Standards including, if recommended by the City Attorney, changes to Division One regarding legal issues. Any change that has a significant policy implication shall be brought to Council for approval.

3. Resolution No. 2456 is hereby repealed.

4. This resolution is effective on January 1, 2006.

City of Gresham
Department of Environmental Services
1333 NW Eastman Parkway
Gresham, Oregon 97030-3813
503-618-2525
Fax 503-661-5927
www.ci.gresham.or.us



Subscribers will receive periodic updates to the Standards. Please notify the City of any changes of address. The form below may be copied for that purpose.

Subscribers are encouraged to report errata and forward any suggestions in the interest of improving the Standards. The City will evaluate all suggestions. Suggestions that are approved and adopted will be included in periodic replacement sheet updates mailed to subscribers.

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Department of Environmental Services
1333 NW Eastman Parkway
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**PUBLIC WORKS STANDARDS
ORDER FORM**

(Name)

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(Organization)

(Department)

(Address)

(City)

(State)

(Zip)

(Phone Number)

(Fax Number)

(E-mail Address)

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_____	Public Works Standards Document	@ \$75.00	_____	_____
_____	Public Works Standards on CD	@ \$25.00	_____	_____
			Grand Total:	=====

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City of Gresham
Department of Environmental Services
1333 NW Eastman Parkway
Gresham, Oregon 97030-3813
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STANDARD DETAIL MODIFICATION PROCEDURE

In the event it is necessary to modify any of the enclosed Standard Detail Drawings, please obtain the “BORDER FOR MODIFIED DETAILS” from the *Public Works Standards* CD and follow the directions as noted. Include the Drawing description at the bottom of the border.

Standard Details

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**Drawing
Number**

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645	PCC Trench Restoration
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MANHOLE FRAME
AND
COVER PER
PLANS/SPECS.

REDUCING TOP SLAB TO BE DESIGNED &
CONSTRUCTED FOR DEPTH AND TRAFFIC
CONDITIONS BY MANUFACTURER. FOR SLABS
WITHIN 1'7" OF STREET, OPENING TO BE 25".

COLLAR

MINIMUM OF 12" PRECAST WALL
BETWEEN PIPE CORING REQ'D.

SEE 301.03.04A
FOR DISTANCE
TO FIRST
FLEXIBLE JOINT

0° PIPE DEFLECTION
SHOWN.

PLAN

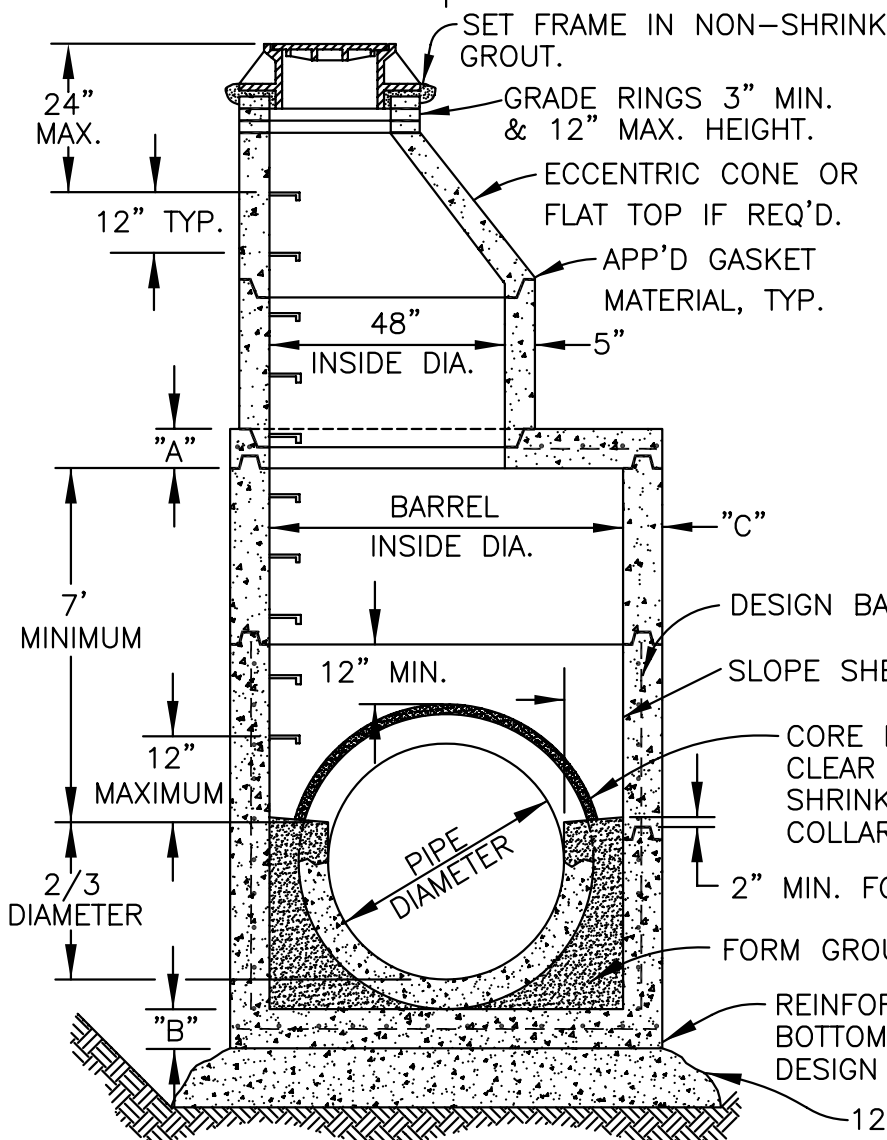
MINIMUMS

PIPE DIA. IN.	BARREL DIA.* IN.	"A" DIM. IN.	"B" DIM. IN.	"C" DIM. IN.
30"	72"	7"	10"	7"
33"	72"	7"	10"	7"
36"	72"	7"	10"	7"
42"	84"	12"	12"	8"
48"	84"	12"	12"	8"
54"	96"	12"	12"	9"
60"	96"	12"	12"	9"
66"	108"	12"	12"	10"
72"	108"	12"	12"	10"
78"	120"	12"	12"	11"
84"	120"	12"	12"	11"
90"	132"	12"	12"	11"
96"	132"	12"	12"	11"

* APPLIES TO (2) PIPE MANHOLES
WITH 0° DEFLECTION. OTHER
NUMBERS OF PIPES OR DEFLECTION
WILL REQUIRE LARGER SIZE.

NOTES:

STEPS TO BE AS DETAILED IN
STANDARD SPECIFICATIONS.



VERTICAL SECTION

DESIGN BARREL REINFORCING FOR CONDITIONS.

SLOPE SHELVES 1:12, 18" MINIMUM WIDTH.

CORE MANHOLE WALL 2" MIN., 4" MAX.
CLEAR OF PIPE WALL. GROUT WITH NON-
SHRINK GROUT & POUR 4"x4" CONCRETE
COLLAR AROUND PIPE CONNECTION.

2" MIN. FOR CAST-IN-PLACE BASE

FORM GROUT CHANNEL TO 2/3 DIA. HEIGHT.

REINFORCED PRE-CAST OR CAST-IN-PLACE
BOTTOM SLAB. SUBMIT CALCULATIONS &
DESIGN FOR PRIOR APPROVAL.

12" MINIMUM THICKNESS OF 3/4"-0"
COMPACTED CRUSHED ROCK.

DRAWN: DLS

DIV.

REV. DATE APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

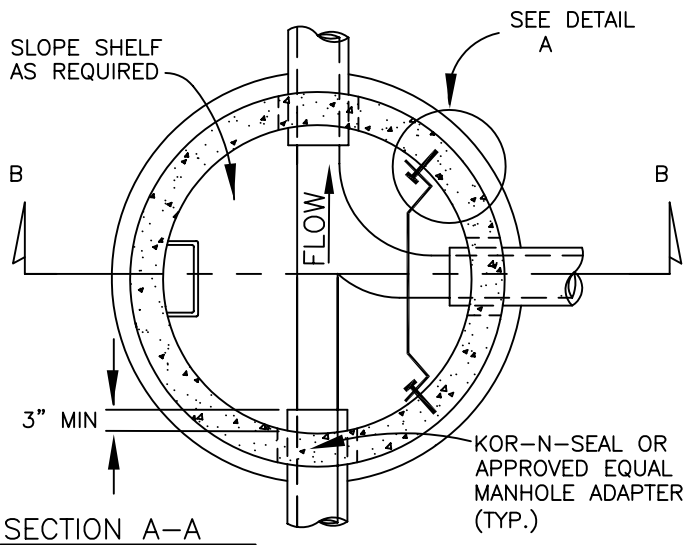
WASTSEWATER & STORMWATER STANDARD MANHOLE
FOR 30" and LARGER DIA. PIPES

SCALE: NTS

DATE: JAN 1, 2006

APPR.

DWG. NO. 302



NOTES:

NO PARTITION SHALL BE INSTALLED IN STORMWATER MANHOLES.

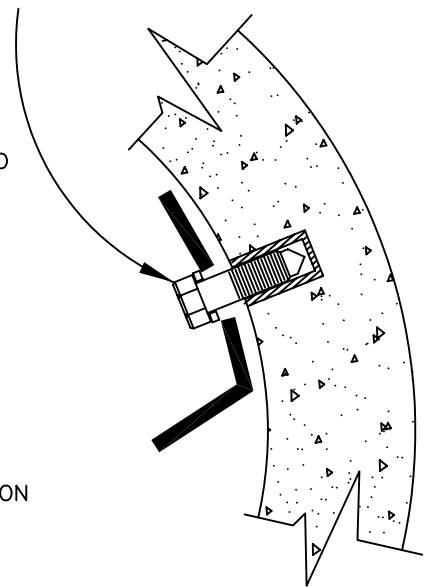
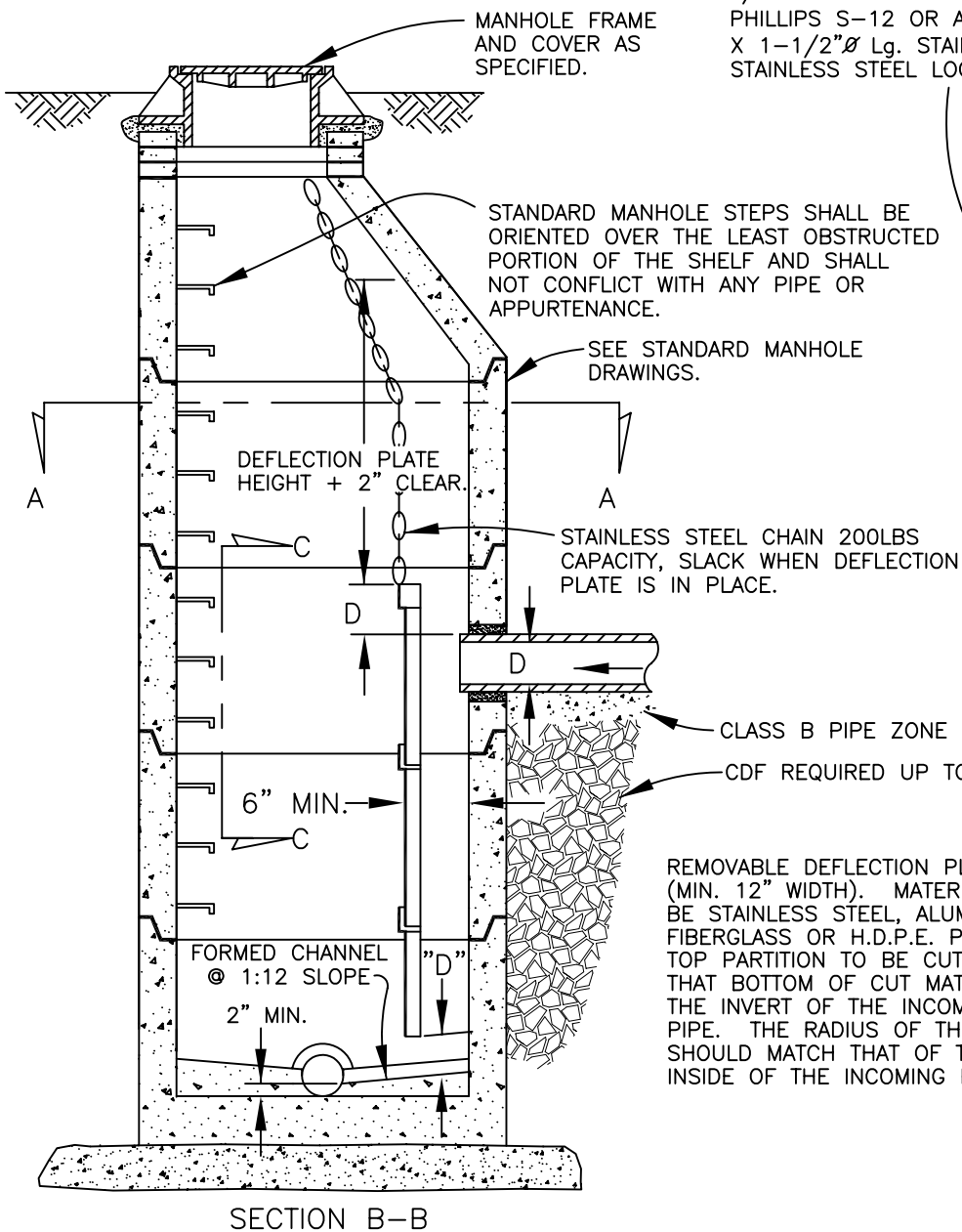
PARTITION MATERIAL SHALL BE 1/2" H.D.P.E (TYP. PER ASSOCIATED PIPE), OR 1/8" FIBERGLASS (TYP. PER PIPE INC.) OR 16 GA. ALUMINUM OR 18 GA. STAINLESS STEEL. FIBERGLASS SHALL BE 3 OR 4 MAT LAYUP PER MANUFACTURERS' RECOMMENDATIONS.

MAXIMUM FLOW IS 3 C.F.S. FOR INSIDE DROP MANHOLE. IF GREATER THAN 3 C.F.S. NO DROP IS ALLOWED.

FOR A 48" DIA. MANHOLE THE MAXIMUM INCOMING PIPE DIAMETER IS 15". A LARGER DIAMETER INCOMING PIPE WILL REQUIRE A SPECIAL DESIGN.

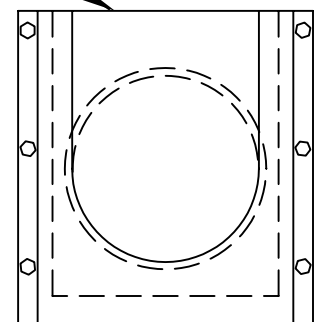
STANDARD TYPE MANHOLE SHOWN. FLATTOP MANHOLE SIMILAR.

1/2"Ø SELF TAPPING CONCRETE ANCHORS, PHILLIPS S-12 OR APPROVED EQUAL, W/ 1/2" X 1-1/2"Ø Lg. STAINLESS STEEL BOLT & STAINLESS STEEL LOCK WASHER.



DETAIL A
(PARTITION ATTACHMENT)

REMOVABLE DEFLECTION PLATE (MIN. 12" WIDTH). MATERIAL TO BE STAINLESS STEEL, ALUMINUM, FIBERGLASS OR H.D.P.E. PLATE. TOP PARTITION TO BE CUT SO THAT BOTTOM OF CUT MATCHES THE INVERT OF THE INCOMING PIPE. THE RADIUS OF THE CUT SHOULD MATCH THAT OF THE INSIDE OF THE INCOMING PIPE.

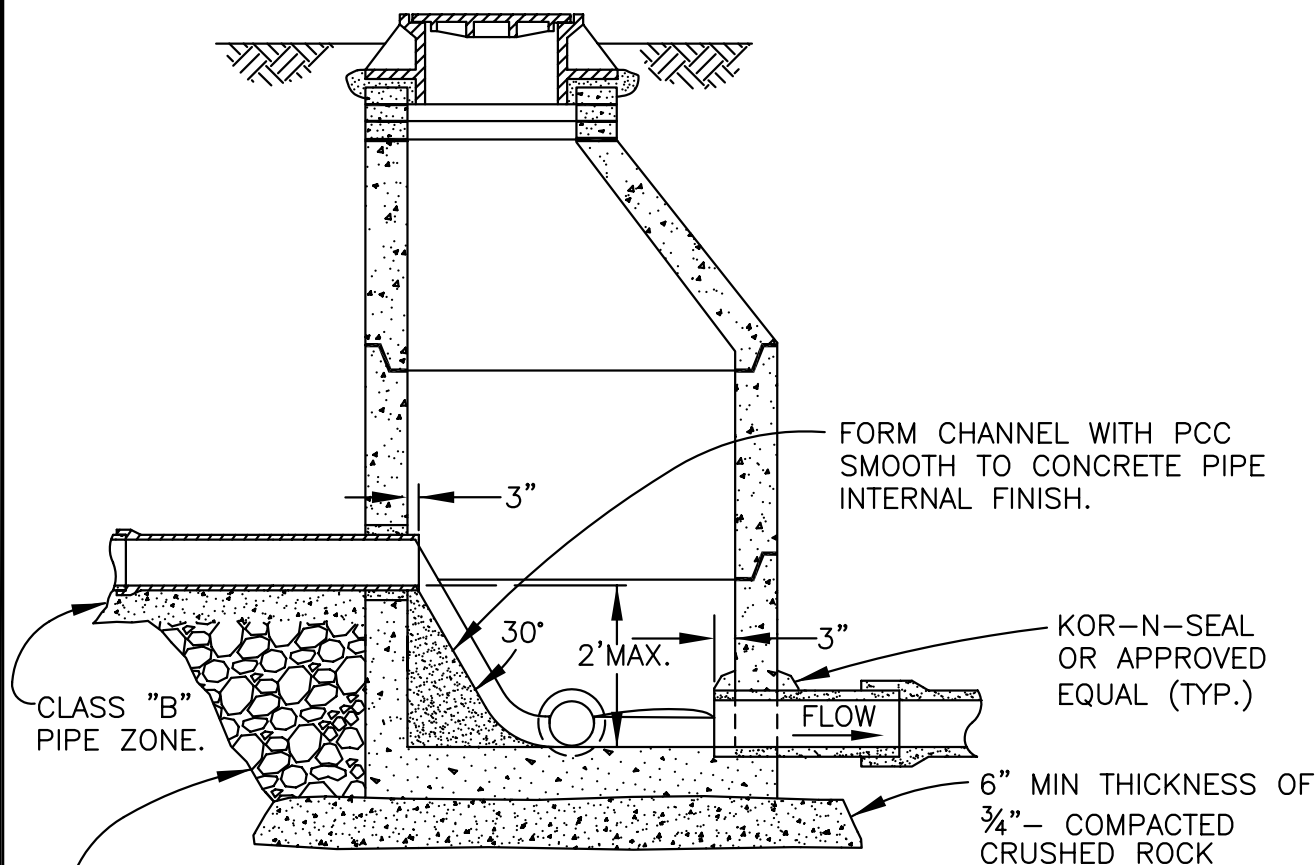


SECTION C-C

DRAWN DLS		
DIV.		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
WASTEWATER AND STORMWATER
STANDARD INSIDE DROP MANHOLE

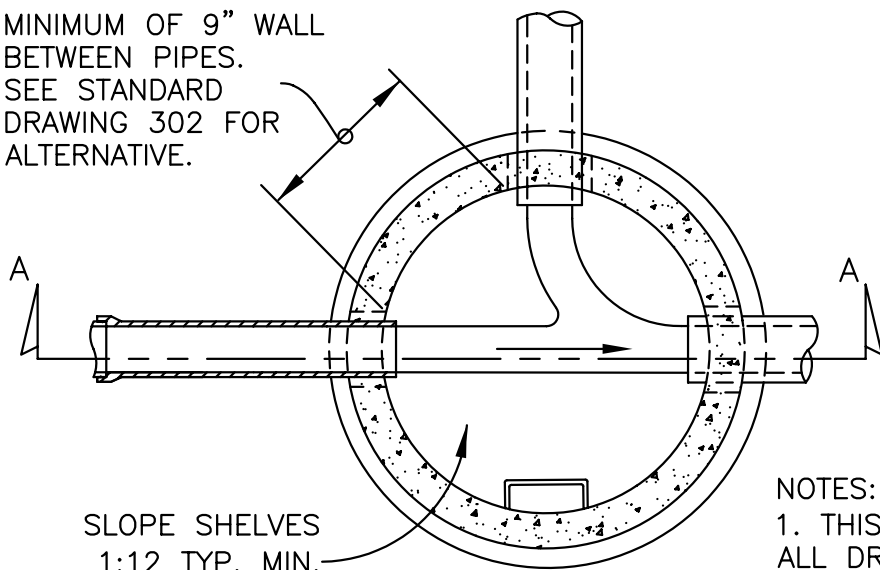
SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	304



SECTION A-A

IMPORTED SELECT (CRUSHED AGGREGATE) BACKFILL COMPACTED TO 95% M.D.D. PER AASHTO T-180, OR C.D.F. AS REQUIRED.


MINIMUM OF 9" WALL BETWEEN PIPES. SEE STANDARD DRAWING 302 FOR ALTERNATIVE.

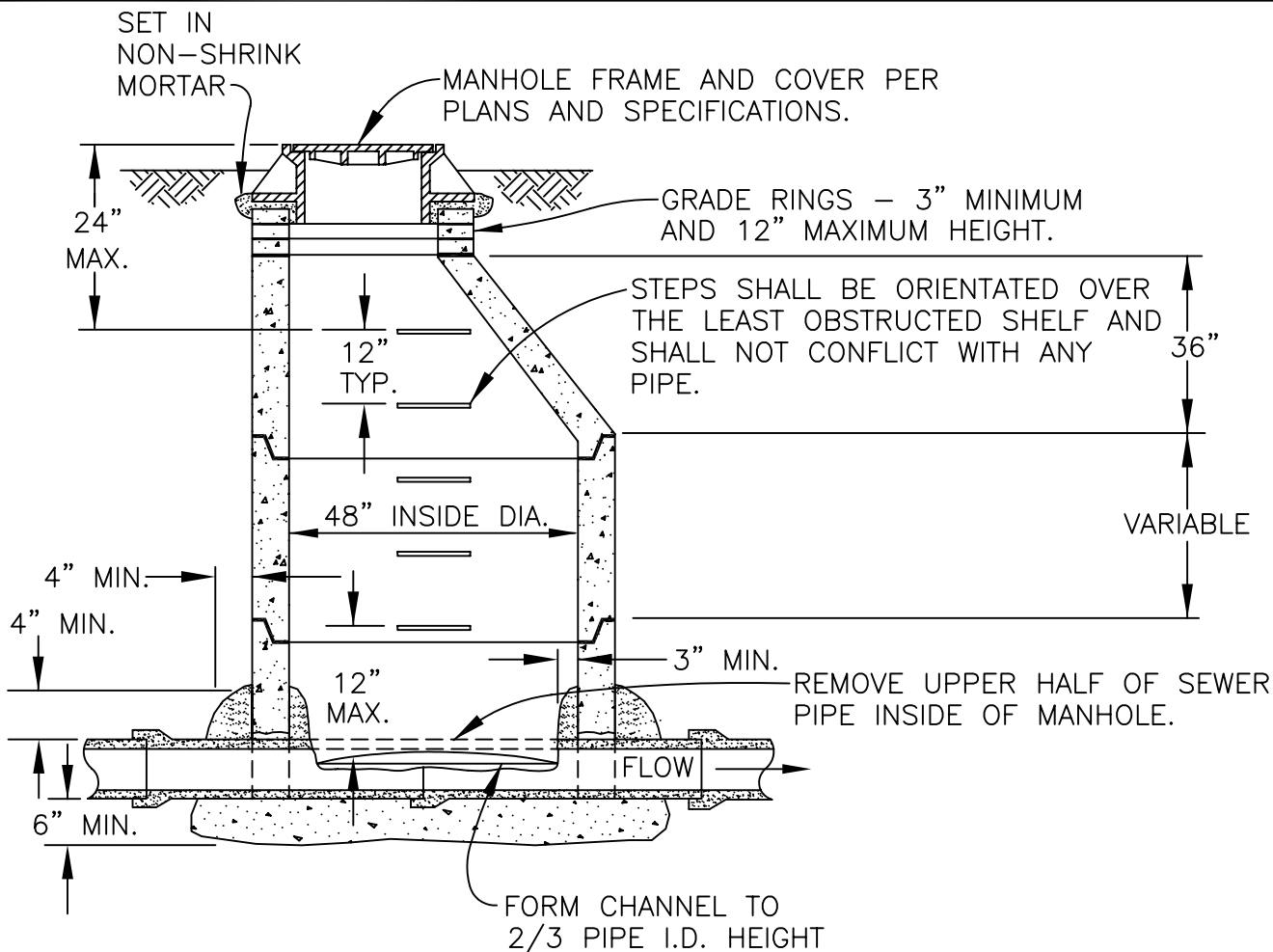


PARTIAL TOP VIEW

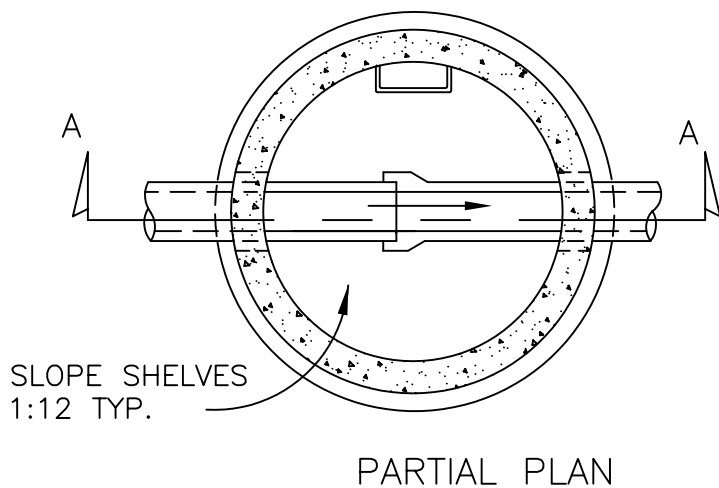
NOTES:

1. THIS DESIGN TO BE USED FOR ALL DROPS 2 FEET AND LESS.
2. SEE DETAILS, 301, 302 OR 303 FOR OTHER DIMENSIONS AND NOTES.

DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.	WASTEWATER SHALLOW INSIDE DROP MANHOLE	APPR. 
				DWG. NO. 305



SECTION A-A



NOTES:

1. JOINTS SHALL BE WATER TIGHT AND COATED WITH WATERPROOF RUBBERIZED MASTIC MATERIAL BEFORE SETTING RISERS AND TOP. INSIDE JOINTS SHALL BE GROUTED.

2. MANHOLES SHALL HAVE A 12" MIN., 24" MAX. BOTTOM RISER. RISER TO BE BEDDED IN THE CAST-IN-PLACE CONCRETE AS THE BASE TAKES ITS' INITIAL SET.

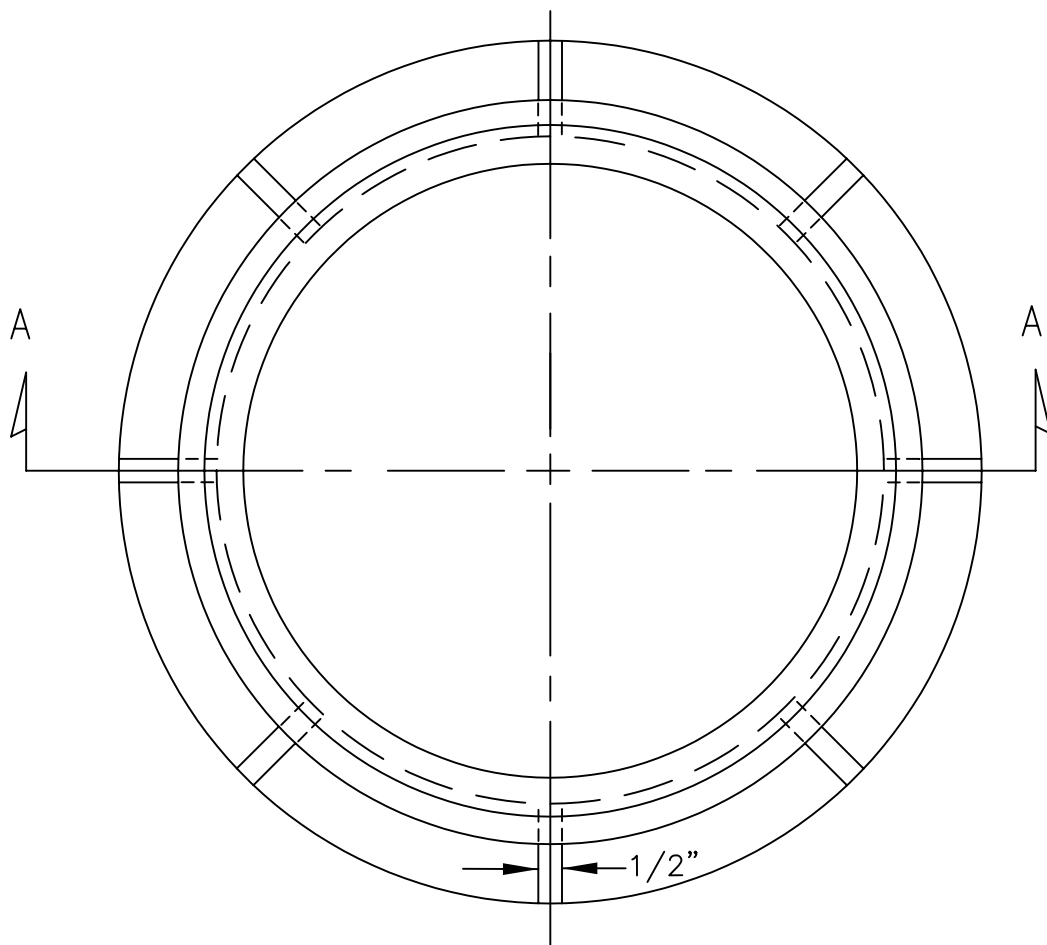
3. 3" TO 12" CLEARANCE BETWEEN BOTTOM RISER SECTION AND TOP OF PIPE. RISER SECTION MUST BE CAST TO ACCOMODATE PIPE (DOG HOUSE) NO SAWING OR BREAKING OF RISER WILL BE ALLOWED.

4. AFTER SHELF IS FORMED REMOVE TOP OF PIPE.

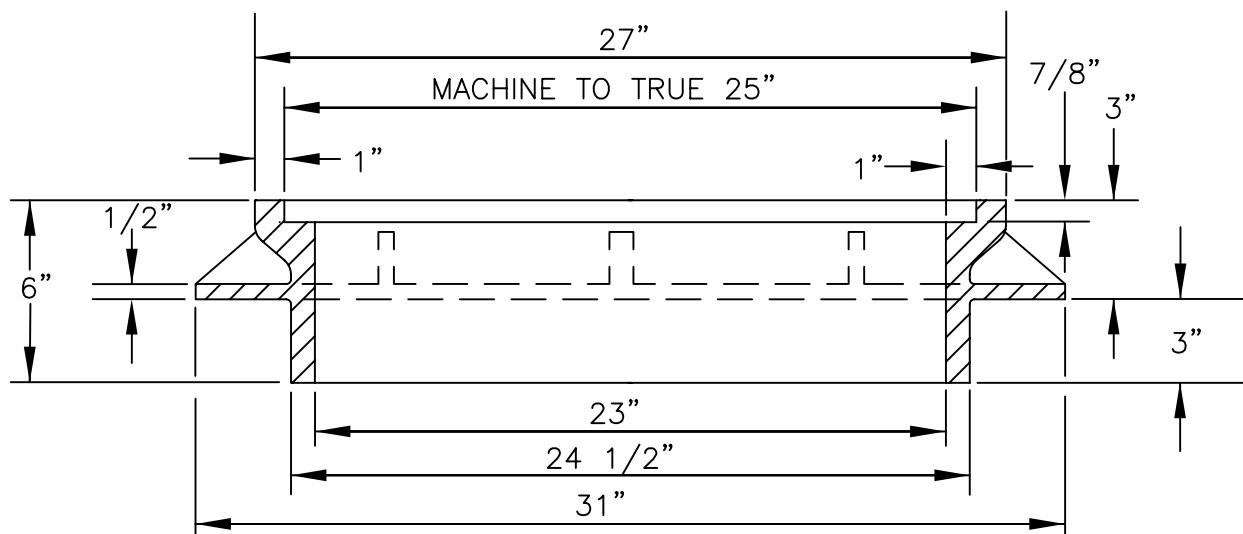
DRAWN	DLS
DIV.	
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
WASTEWATER AND STORMWATER
CAST IN PLACE MANHOLE

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>OR</i>
DWG. NO.	306



PLAN SECTION



SECTION A-A

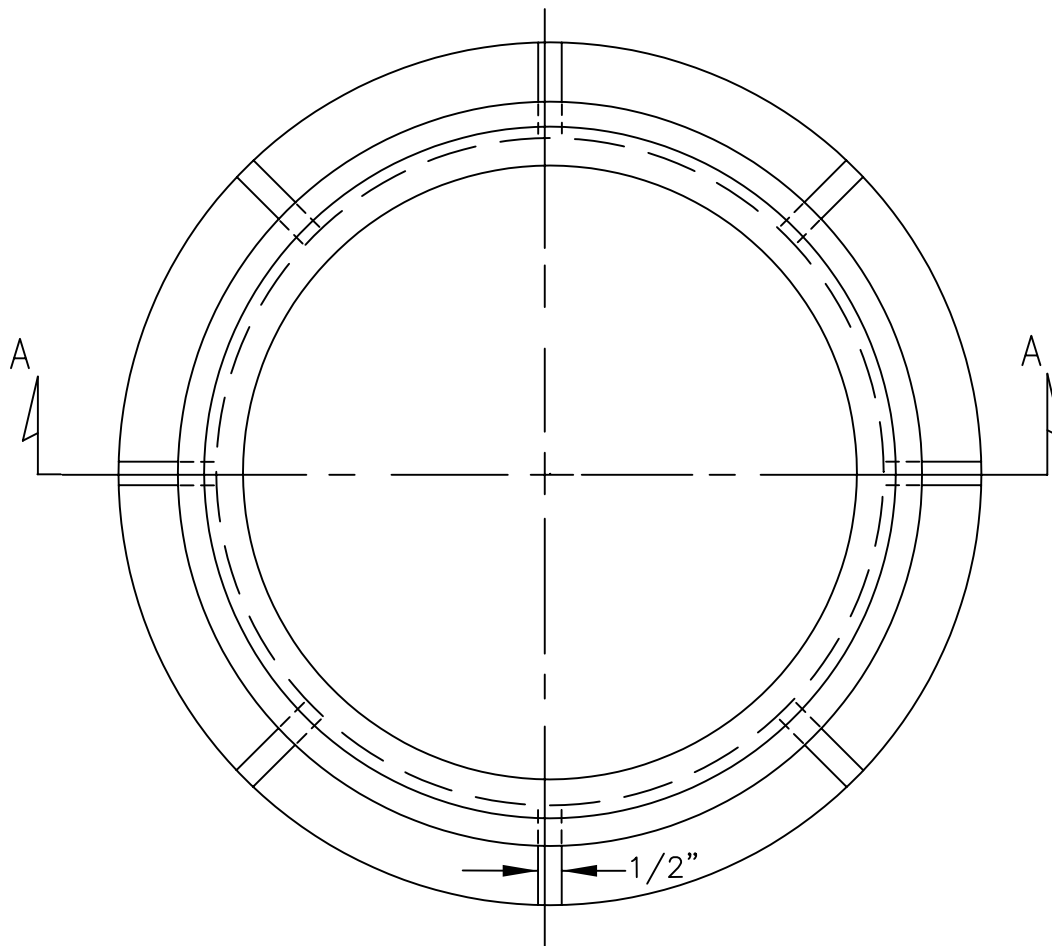
NOTES:

1. THIS MANHOLE FRAME MAY BE USED ONLY FOR LOCAL ROAD LOCATIONS.
2. MATERIAL TO BE GRAY CAST IRON ASTM A-48, CLASS 30. APPROX. WEIGHT = 172 LBS.

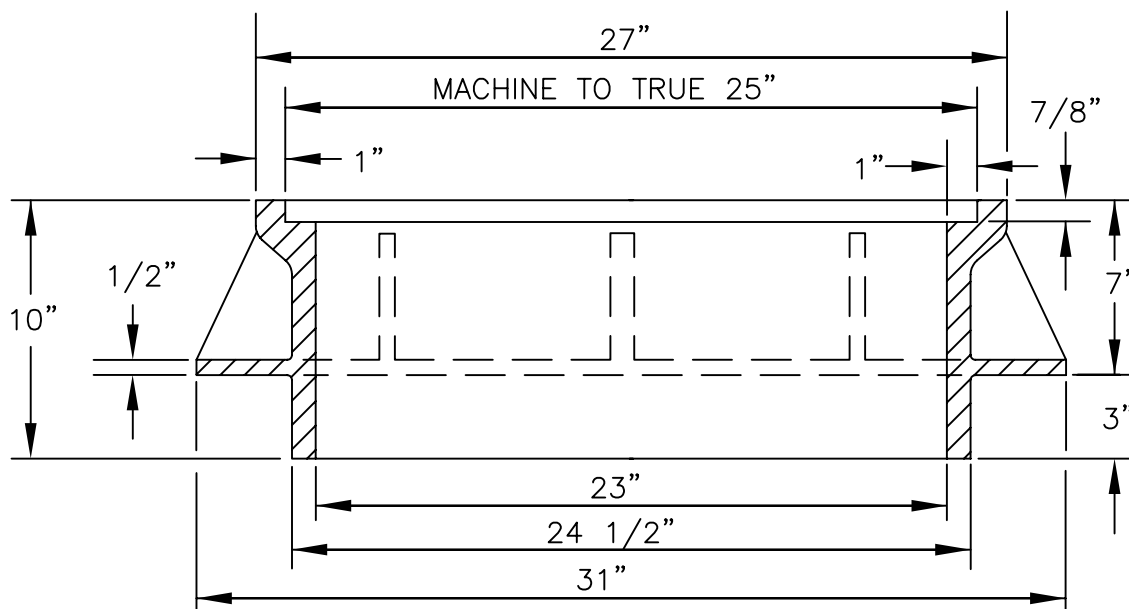
DRAWN	DLS	
DIV.		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
WASTEWATER AND STORMWATER SUBURBAN MANHOLE FRAME		

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	307




PLAN



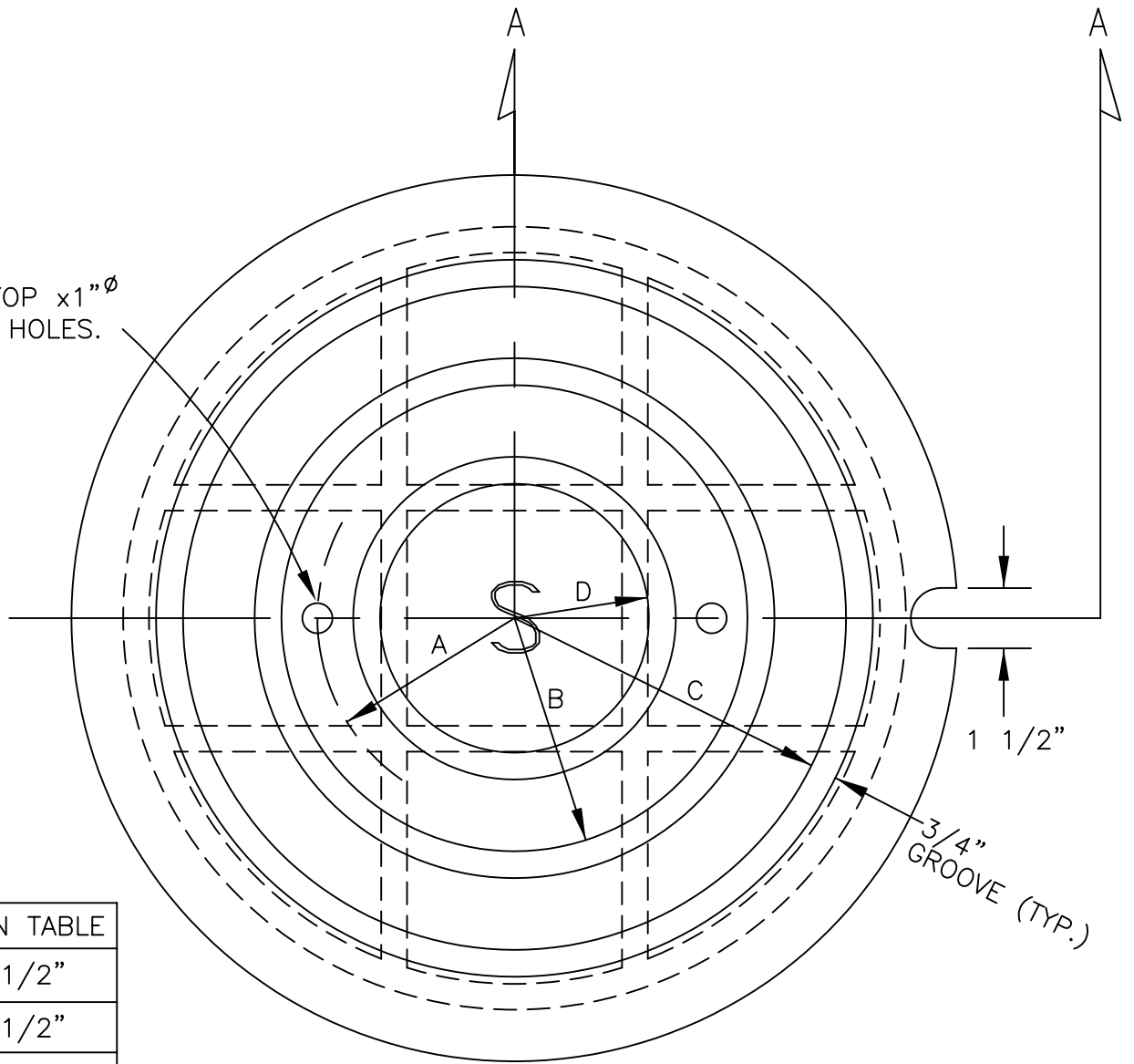
SECTION A-A

NOTE:

1. MATERIAL TO BE GRAY CAST
IRON ASTM-48, CLASS 30,
APPROXIMATE WEIGHT = 237 LBS.

DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 INDUSTRIAL MANHOLE FRAME	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 308

3/4"Ø TOP x 1"Ø
BOTTOM HOLES.



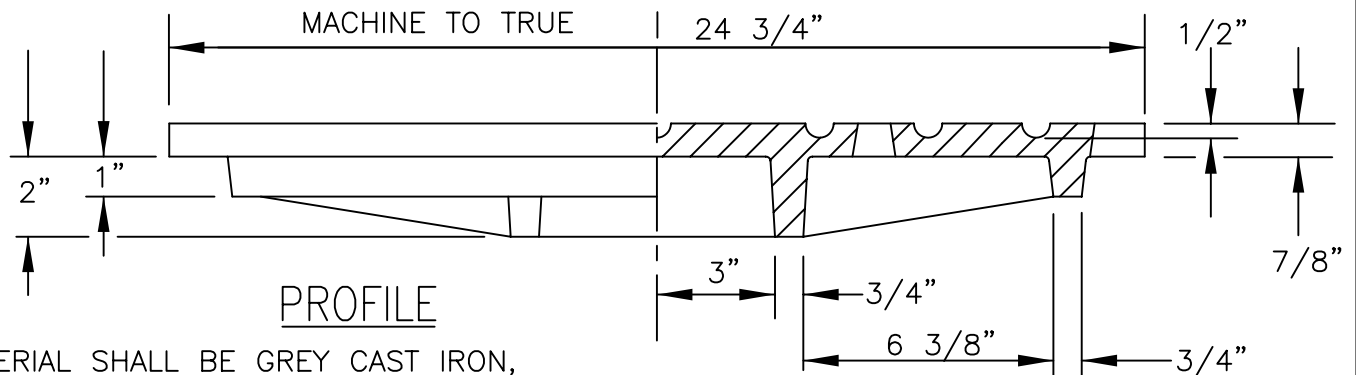
1 1/2"

3/4" GROOVE (TYP.)

DIMENSION TABLE

A	5 1/2"
B	6 1/2"
C	9 1/4"
D	3 3/4"

PLAN



PROFILE

SECTION A-A

NOTES:

1. MATERIAL SHALL BE GREY CAST IRON,
ASTM A- 48, CLASS 30.
APPROXIMATE WT. = 139 lbs.

2. THESE COVERS TO BE USED FOR
IN-ROAD LOCATIONS ONLY.

DRAWN	DLS
DIV.	
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

STANDARD WASTEWATER
MANHOLE COVER

SCALE NTS

DATE JAN 1, 2006

APPR. *CR*

DWG. NO. 310

DRILL 5/8" ϕ HOLE
COUNTERBORE 1 7/16" ϕ
1/2" DEEP (TYP)

3/4" ϕ TOP x 1" ϕ
BOTTOM HOLES

1 1/4" RADIUS
(TYP.)

120° (TYP.)

DRILL & TAP HOLE

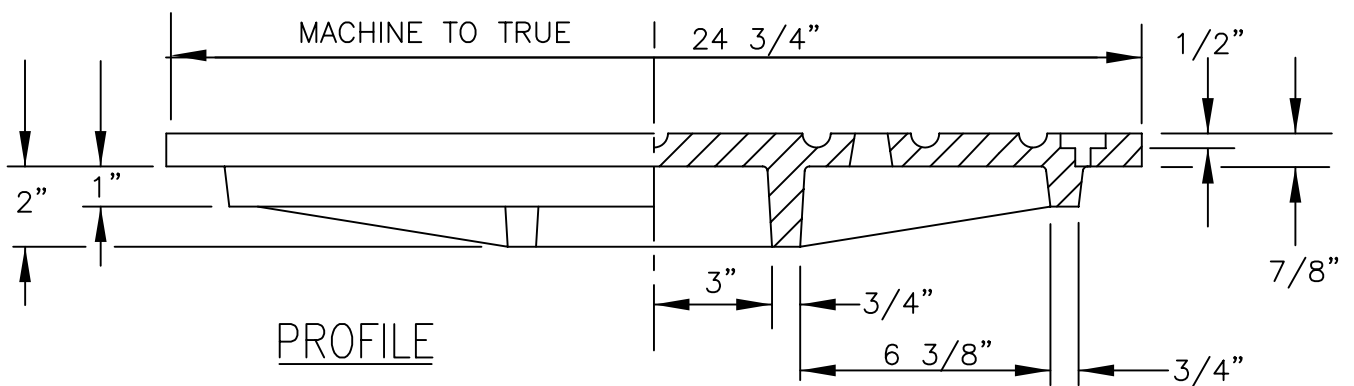
1 1/2"
3/4" GROOVE (TYP.)

DIMENSION TABLE	
A	5 1/2"
B	6 1/2"
C	9 1/4"
D	3 3/4"
E	10 7/8"

1/2" -13 NC x 1 1/4" STAINLESS
STEEL HEX HEAD CAP SCREW W/ 1 1/4"
OD x 3/32" THK. 8-18 STAINLESS STEEL
WASHER & 3/32" NEOPRENE WASHER. (3)
EA. REQUIRED.

PLAN

LOCKDOWN DETAIL



NOTE:

1. MATERIAL SHALL BE GREY CAST IRON, ASTM A-48,
CLASS 30. APPROXIMATE WT. = 139 lbs.

DRAWN DLS		
DIV.		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

WASTEWATER MANHOLE
TAMPERPROOF COVER

SCALE NTS

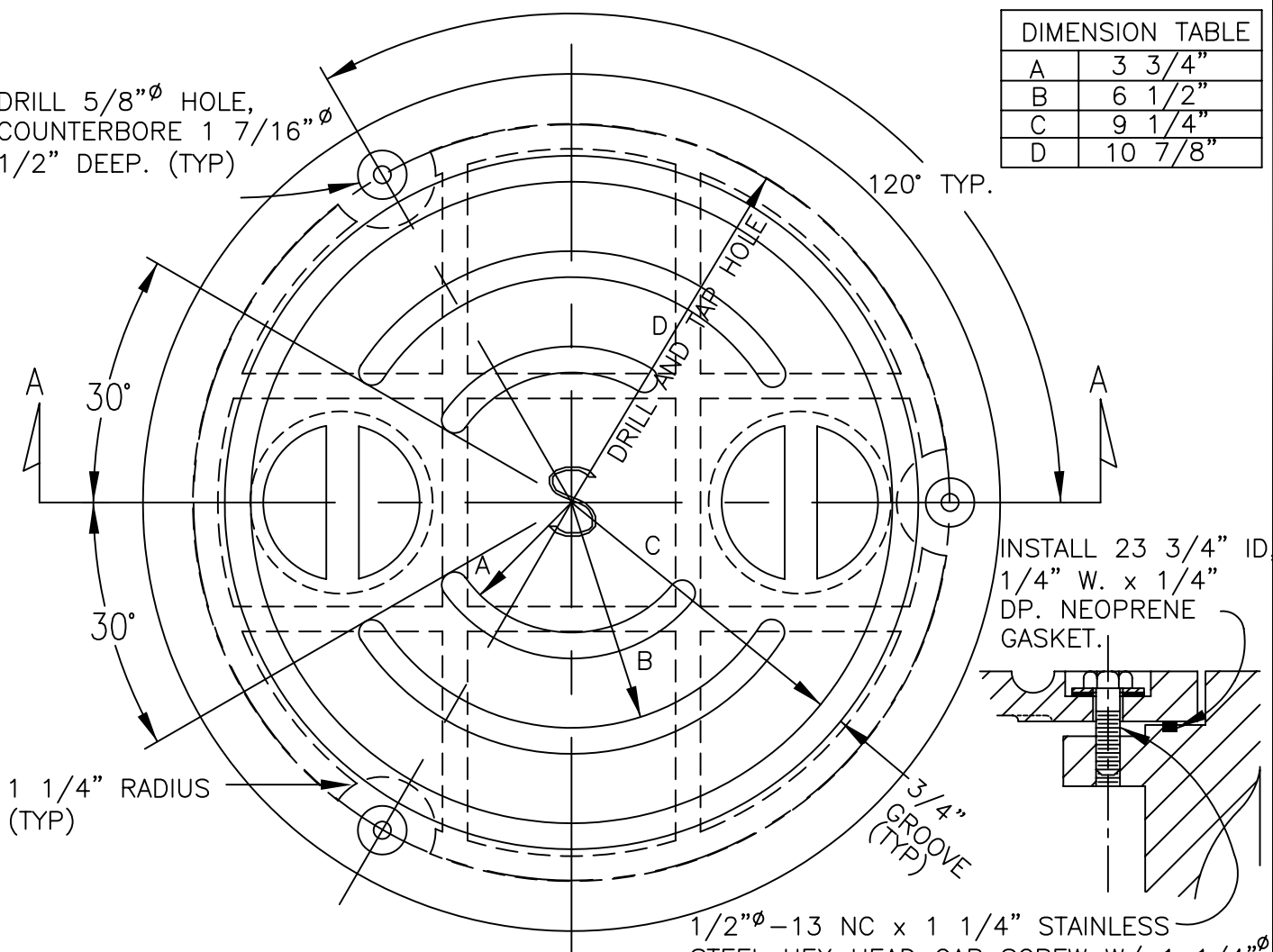
DATE JAN 1, 2006

APPR. *OR*

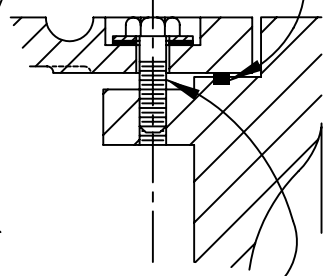
DWG. NO. 311

DIMENSION TABLE	
A	3 3/4"
B	6 1/2"
C	9 1/4"
D	10 7/8"

DRILL 5/8"Ø HOLE,
COUNTERBORE 1 7/16"Ø
1/2" DEEP. (TYP)



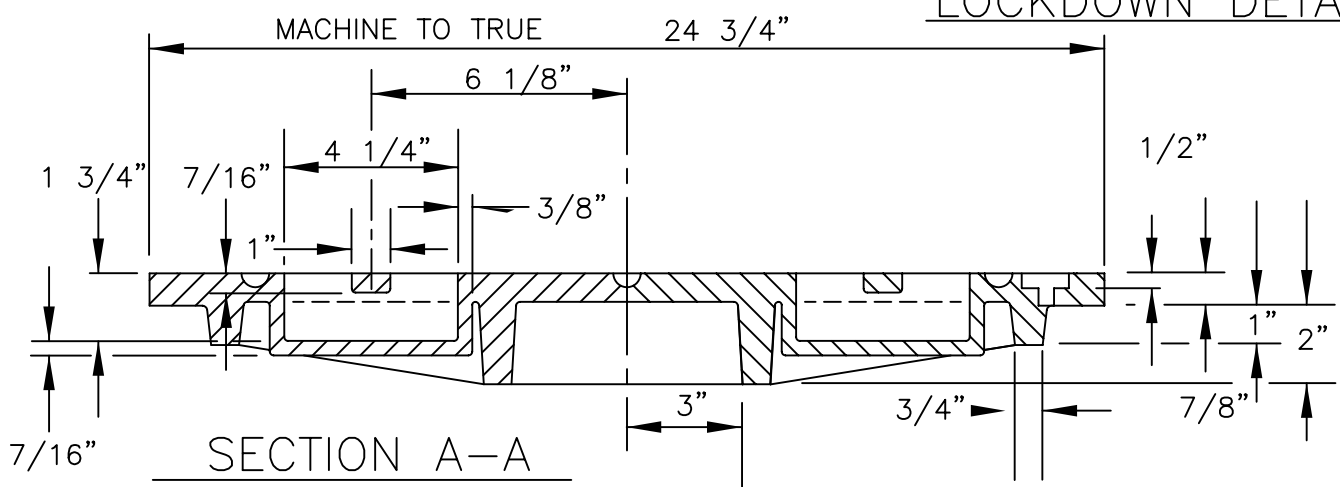
INSTALL 23 3/4" ID
1/4" W. x 1/4"
DP. NEOPRENE
GASKET.



1/2"Ø-13 NC x 1 1/4" STAINLESS
STEEL HEX HEAD CAP SCREW W/ 1 1/4"Ø
OD x 3/32" THK. 8-18 STAINLESS STEEL
WASHER & 3/32" NEOPRENE WASHER. (3)
EA. REQUIRED.


PLAN

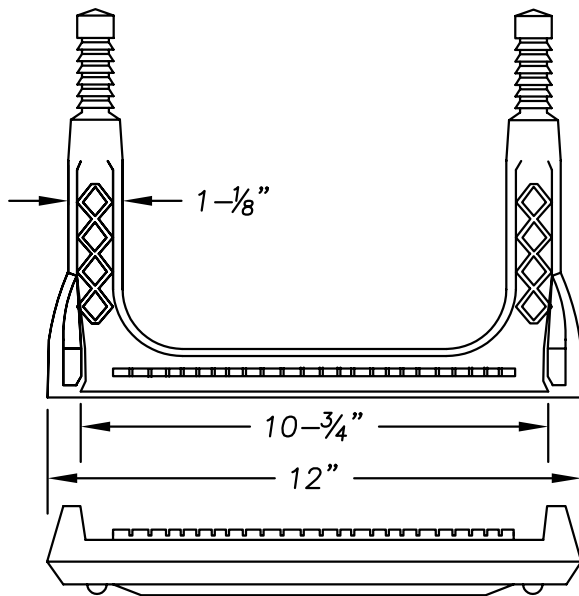
LOCKDOWN DETAIL



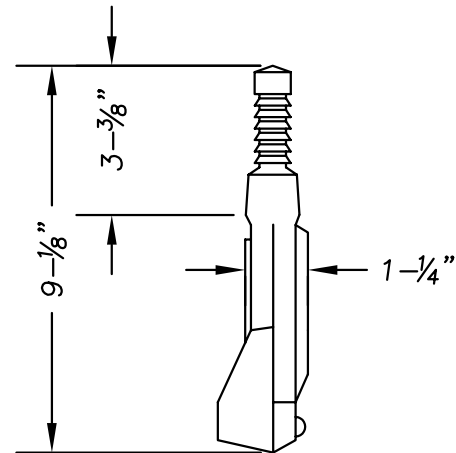
NOTES:

1. MATERIAL SHALL BE GRAY CAST IRON, ASTM A-48, CLASS 30. APPROXIMATE Wt. = 139 lbs

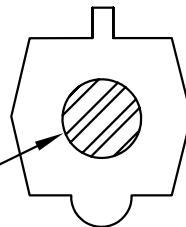
DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 WASTEWATER WATERPROOF MANHOLE COVER	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 312



COPOLYMER POLYPROPYLENE PLASTIC



$\frac{1}{2}$ " GRADE 60 REINFORCEMENT



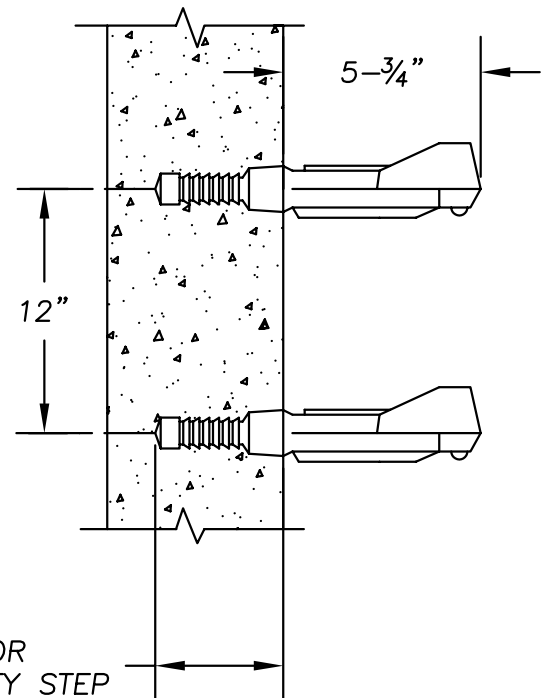
NOTE:

MANHOLE STEPS MUST BE TIGHT AND FIRMLY EMBEDDED. THEY MUST ALSO MEET THE ASTM TEST FOR WITHSTANDING PULLING OUT.

MATERIALS:

PLASTIC:

MUST CONFORM WITH ASTM C-478.
STEEL REINFORCING BAR MINIMUM $\frac{1}{2}$ " GRADE 60 MEETING REQUIREMENTS OF ASTM A-615
ENCAPSULATED WITH INJECTION MOLDED COPOLYMER POLYPROPYLENE WITH SERRATED SURFACES.



$3\text{--}\frac{3}{8}$ " FOR
PLASTIC SAFETY STEP

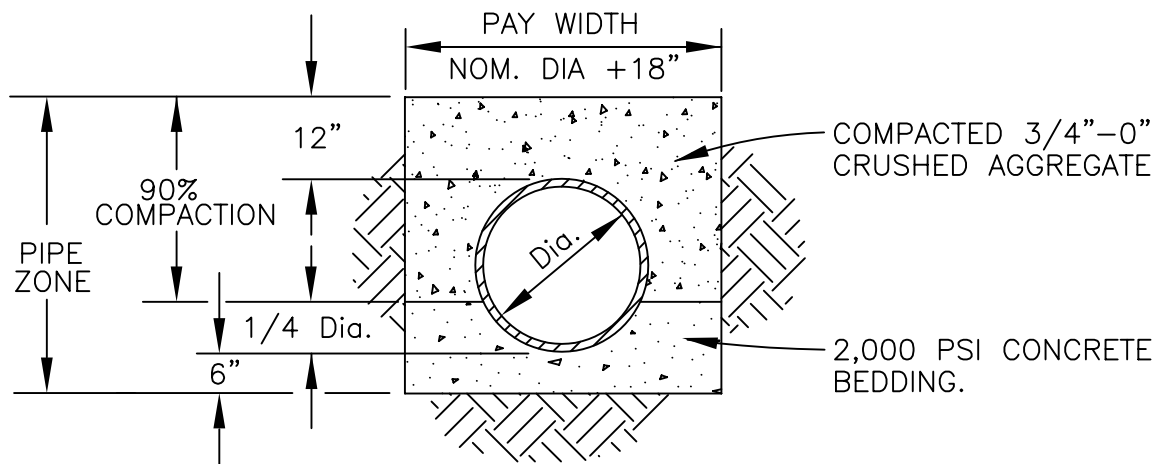
DRAWN: TNP		
DIV. STORMWATER/WASTEWATER		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

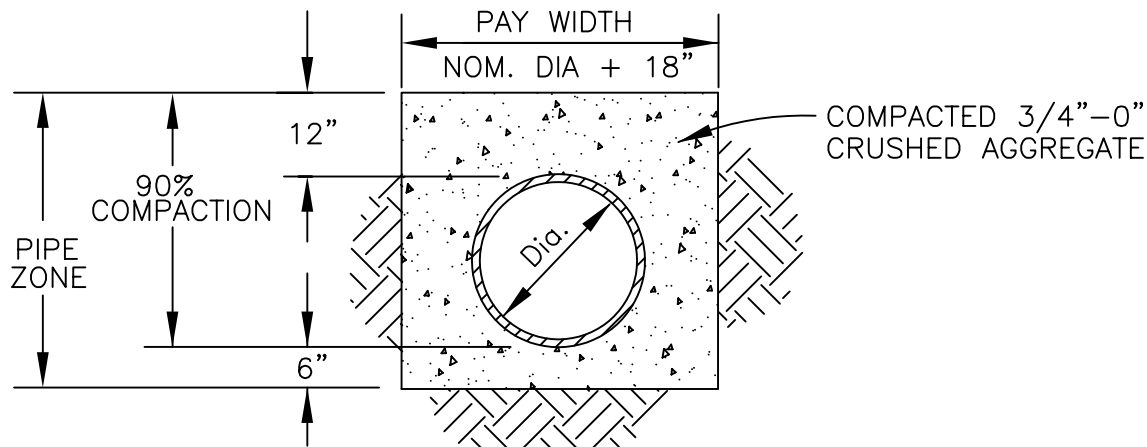
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

MANHOLE STEP DETAIL

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>OR</i>
DWG. NO.	313



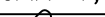
CLASS A

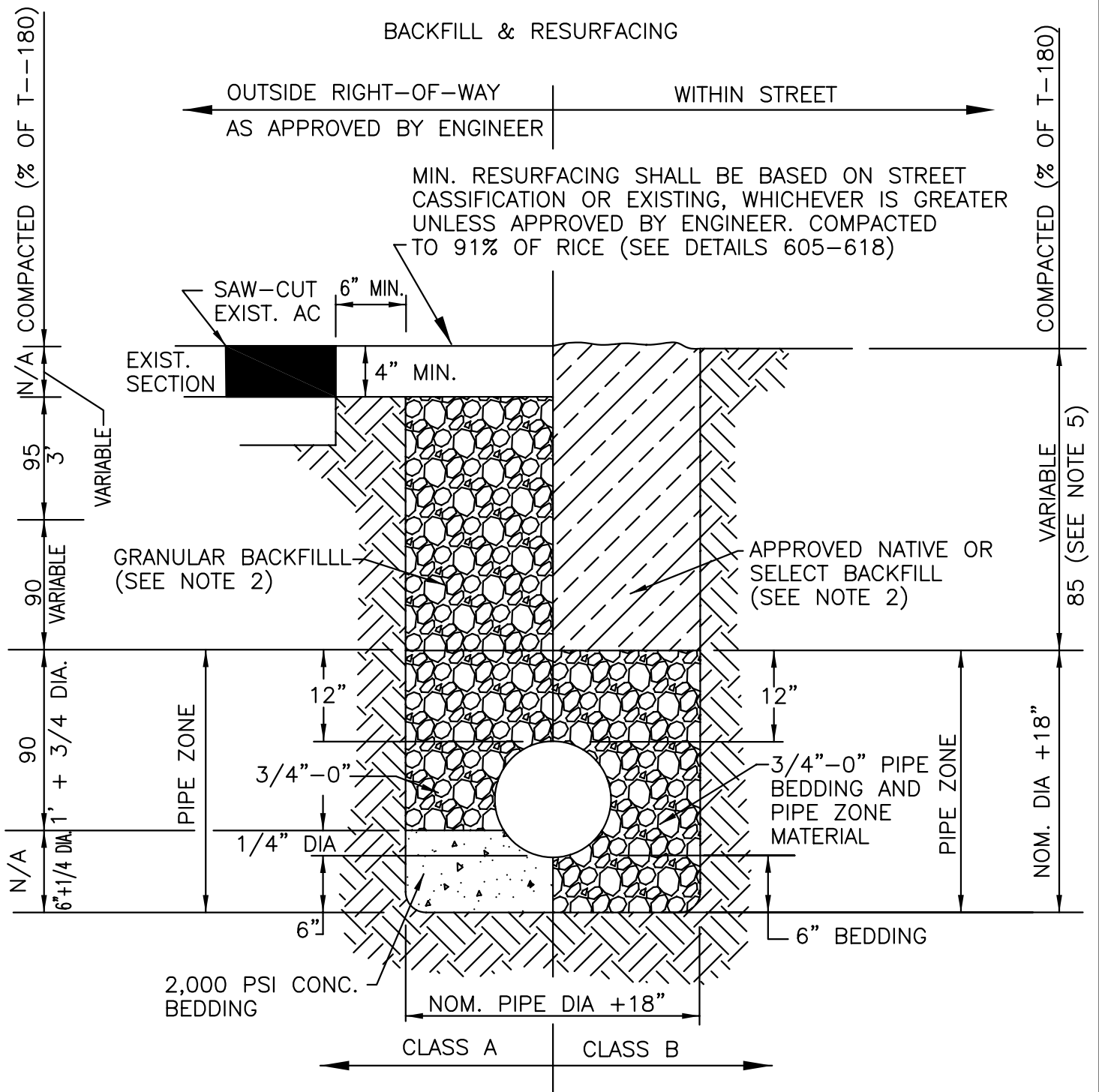


CLASS B

NOTE:

1. WHERE REQUIRED BY THE ENGINEER OF RECORD OR THE CITY, GRANULAR TRENCH STABILIZATION SHALL BE PLACED PRIOR TO THE PIPE ZONE MATERIAL. SIZE AND DEPTH OF TRENCH STABILIZATION PER SOIL CONDITIONS
2. PIPE ZONE MATERIAL SHALL BE COMPACTED TO 90% OF AASHTO - 180
3. PIPE ZONE MATERIAL SHALL BE COMPACTED AS SPECIFIED PRIOR TO BACKFILLING THE REMAINDER OF THE TRENCH.

DRAWN			DLS			<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>WASTEWATER AND STORMWATER</div> <div>PIPE ZONE BEDDING and BACKFILL</div>	SCALE	NTS
DIV.							DATE	JAN 1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	314



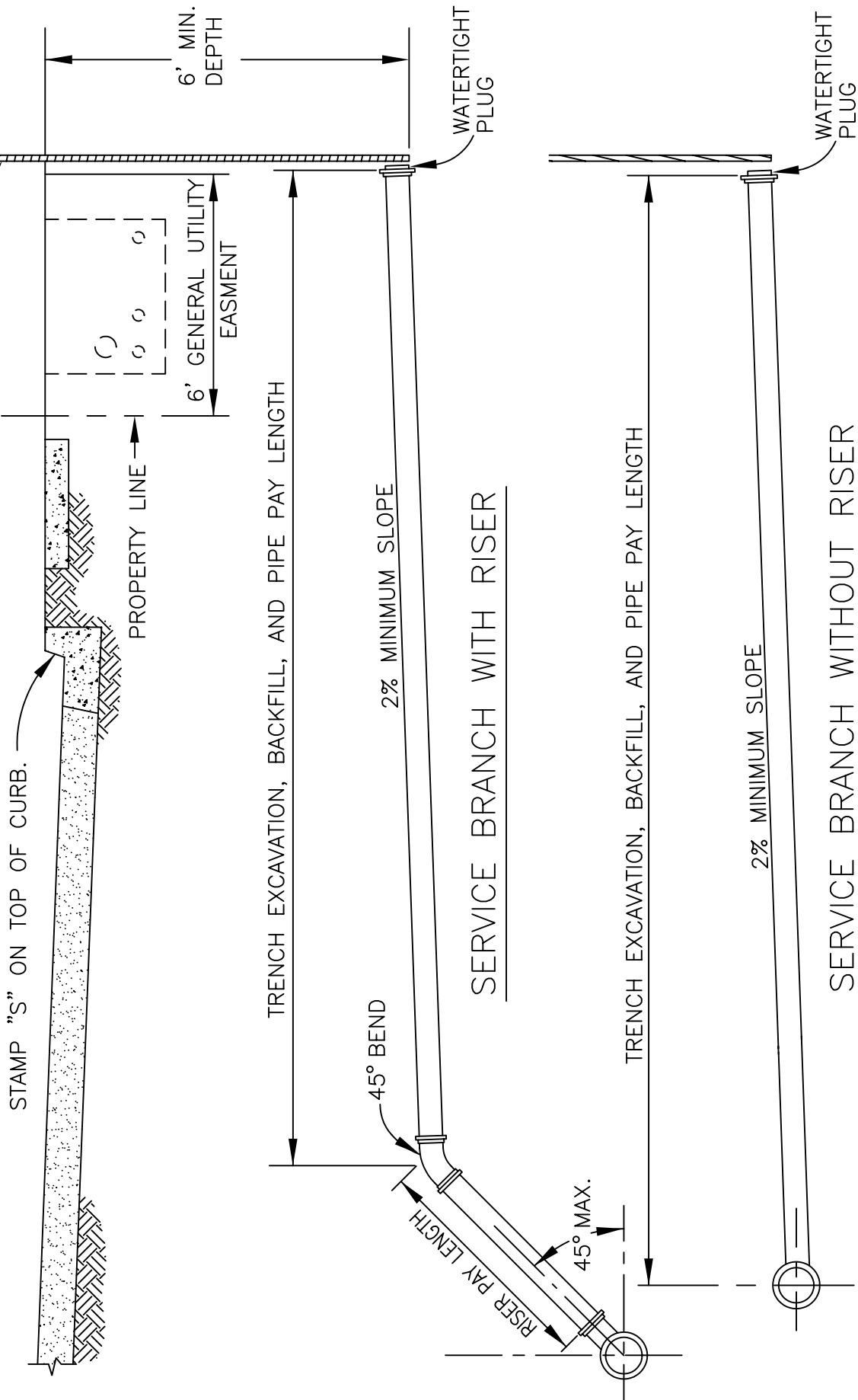
NOTES:

1. ALL CUT EDGES SHALL BE SAND SEALED WITH ASPHALT
2. USE C.D.F. WHERE SPECIFIED AND WHERE REQUIRED BY THE ENGINEER.
3. THIS TRENCH BACKFILL REQUIRED APPLIES TO ALL UTILITIES EXCEPT WATER (SEE DETAIL 502 FOR WATER)
4. WHEN USING GEOTEXTILE FABRIC IT SHALL BE PLACED BELOW THE RESURFACING IN THE "TEE CUT" AREA EXTENDING A MINIMUM OF 6" BEYOND THE TRENCH WALLS.
5. IN AREAS WHERE NATIVE BACKFILL IS BROUGHT TO THE SURFACE AND IS TO BE SEEDED, DO NOT COMPACT THE TOP 2".

DRAWN	AJB
DIV.	TRANSPORTATION
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
TRENCH & RESURFACING DETAIL

SCALE	NTS
DATE	JAN. 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	315



NOTES:

1. SERVICE SHALL NOT BE BACKFILLED PRIOR TO INSPECTION.


2. GREEN MAGNETIC TAPE WITH "WASTEWATER" IN RED LETTERS SHALL BE WRAPPED AROUND THE PLUG AT THE END OF THE SEWER LATERAL AND BROUGHT TO THE SURFACE WRAPPED AROUND THE 2" X 4" MARKER

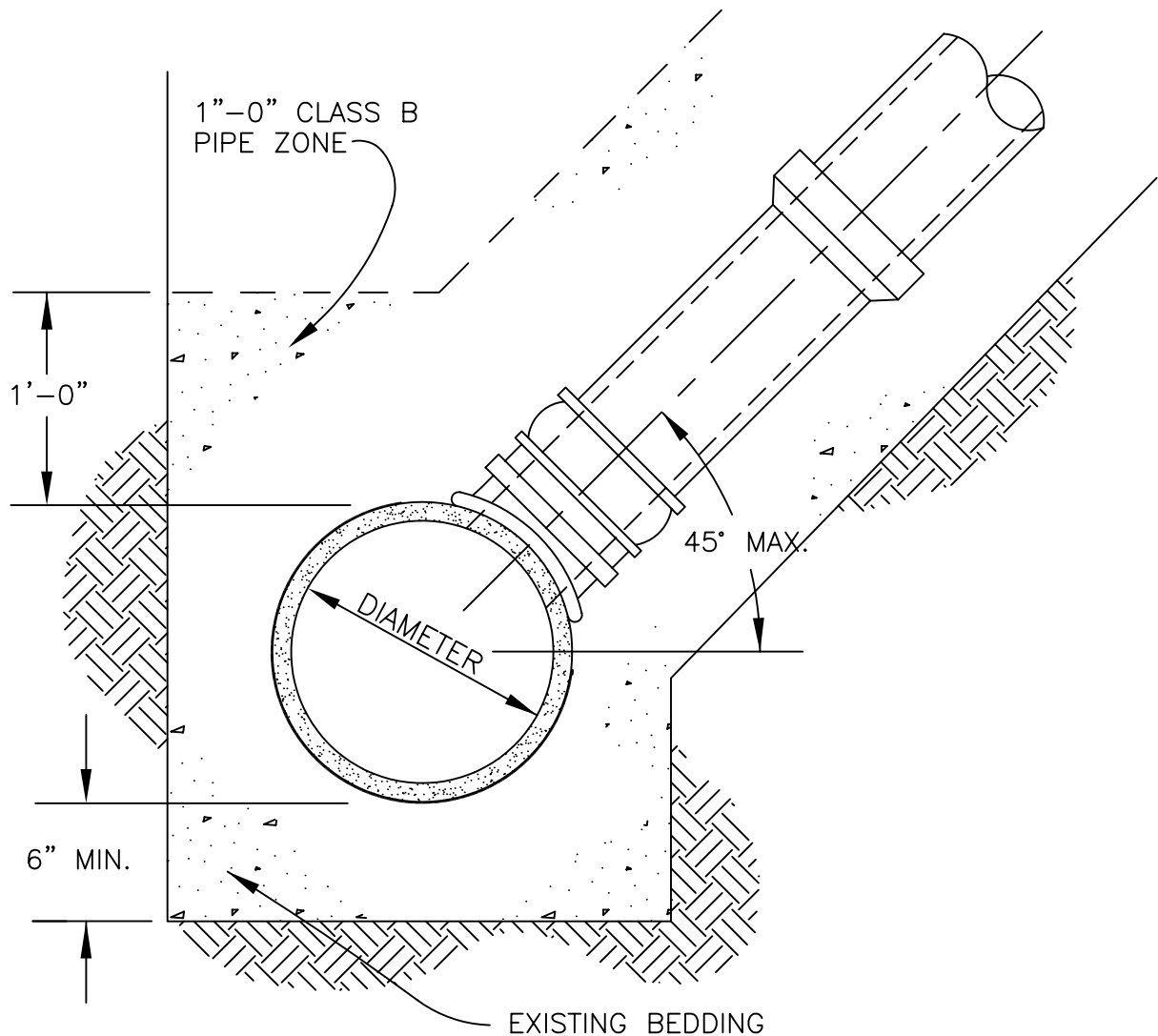
DRAWN		DLS
DIV.		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030


SEWER LATERAL

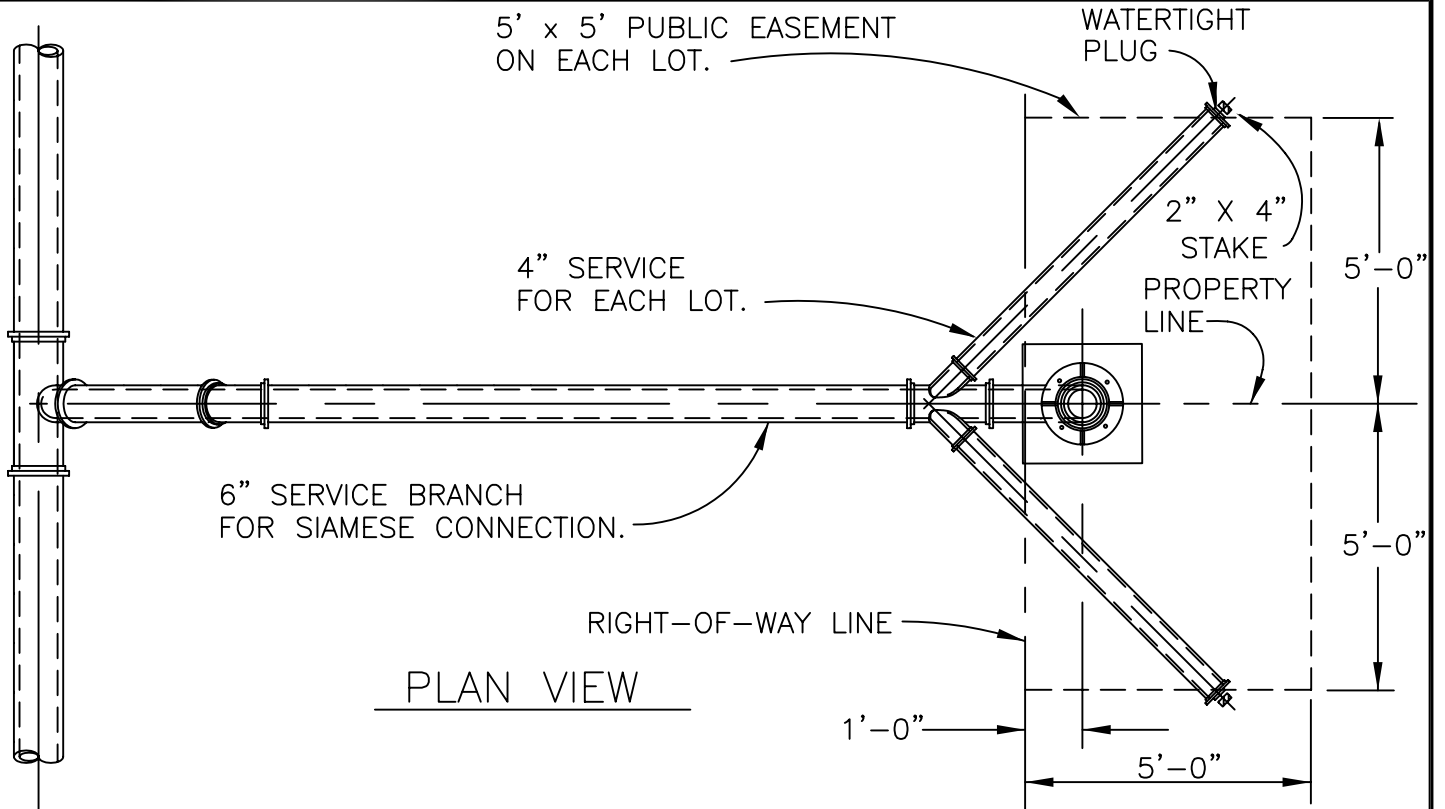
SCALE	NTS
DATE	JAN 1, 2006
APPR.	
DWG. NO.	316



NOTES:

1. THE TAP SHALL NOT BE MADE EXCEPT IN THE PRESENCE OF A CITY INSPECTOR; NOR SHALL ANY CONNECTION BE MADE WITHOUT CITY APPROVAL.
2. A "INSERT-A-TEE" OR "FERNCO" TYPE CONNECTION SHALL BE USED. AND SHALL BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS
3. THE HOLE MADE IN MAIN SHALL BE CORED.
4. ϕ OF TAP TO BE ABOVE SPRINGLINE.
5. 4" MAXIMUM HOLE FOR 8" MAIN UNLESS OTHERWISE APPROVED BY THE ENGINEER

DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 TAP IN EXISTING WASTEWATER MAIN FOR SEWER LATERAL	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 317



SEE STD. DWG. 321
FOR CLEANOUT
INFORMATION AND
NOTES.

STAMP "S" ON TOP OF CURB

SEE DETAIL 316
FOR ADDITIONAL INFORMATION.

PROPERTY LINE

VERTICAL SECTION

NOTE:

1. SERVICE SHALL NOT BE BACKFILLED PRIOR TO INSPECTION.

DRAWN	DLS
DIV.	
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

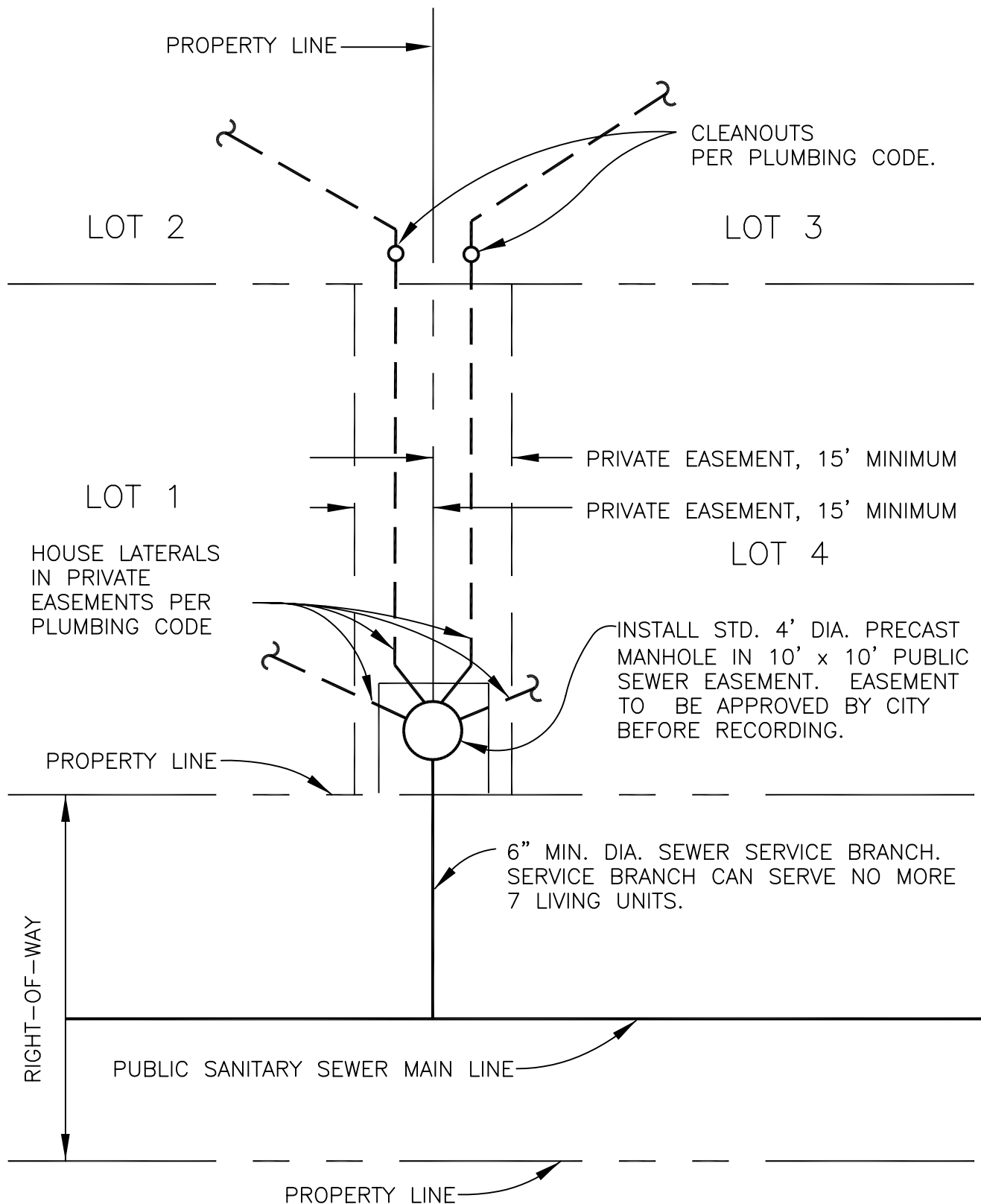
SIAMESE SERVICE BRANCH

SCALE NTS

DATE: JAN 1, 2006


APPR.

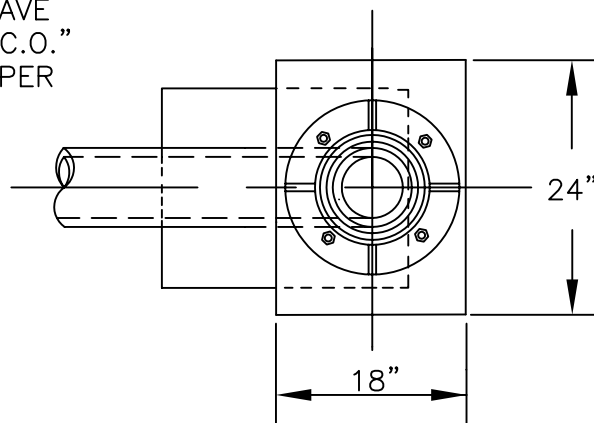
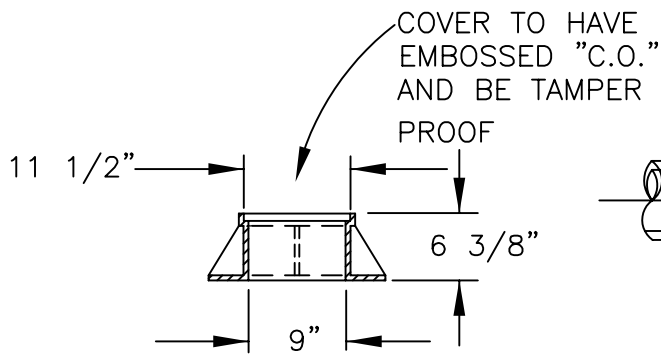
DWG. NO. 318



NOTES:

1. CONNECTION PLAN FOR 4 LOT COMMON LATERAL (3 LOTS SIMILAR).
2. EASEMENTS TO BE RECORDED & A COPY THEREOF SUBMITTED TO CITY CITY PRIOR TO CONSTRUCTION.
3. PRIVATE EASMENT ARRANGMENT SHOWN TO BE USED ONLY WHEN SEWER IN PUBLIC ROAD RIGHT-OF-WAY CANNOT BE USED AS, AS DETERMINED BY THE ENGINEER

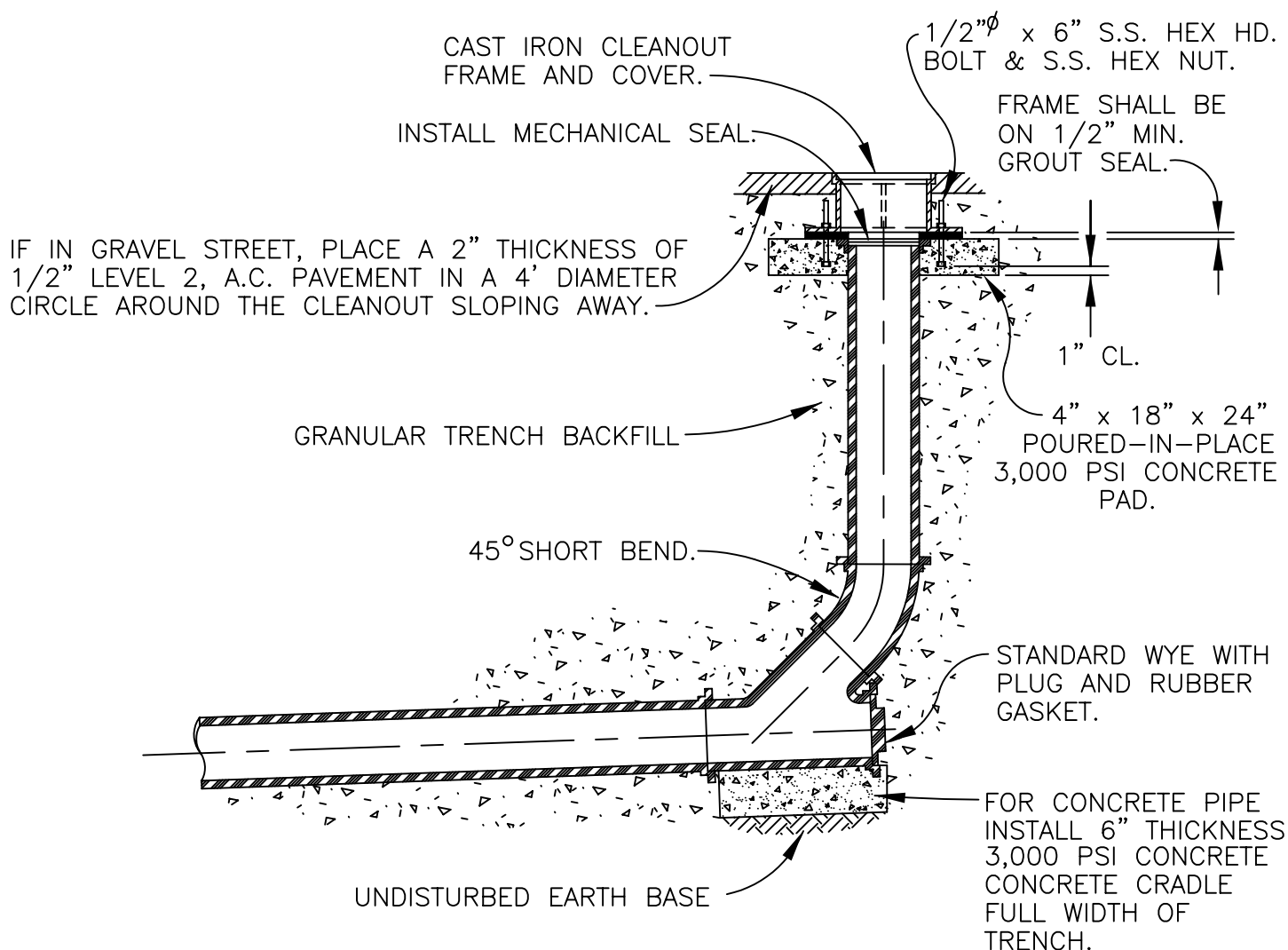
DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 WASTEWATER CONNECTION, 3 or 4 LOTS w/ PRIVATE EASEMENTS	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 319



FRAME & COVER

SALEM IRON WKS.
#4233 & 4234 OR EQUAL.

PLAN



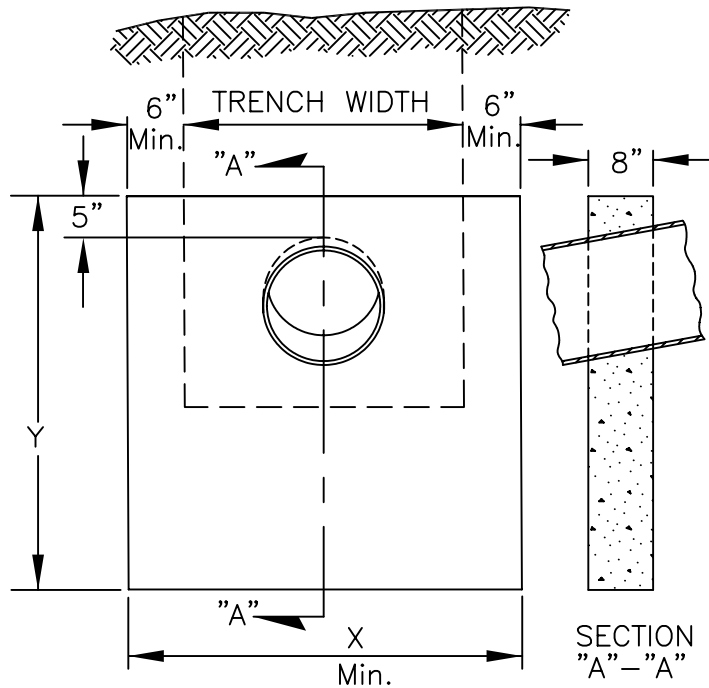
ELEVATION

DRAWN DLS		
DIV.		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

STANDARD CLEANOUT

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	320



DIMENSION TABLE			
PIPE DIA.	X, MIN (ft)	Y (ft)	MIN VOL(cy)
6" TO 10"	4	3	0.29
12" TO 15"	4	4	0.37
18" TO 24"	5	4	0.42
> 24"	TO BE DETERMINED BY ENGINEER OF RECORD		

NOTES:

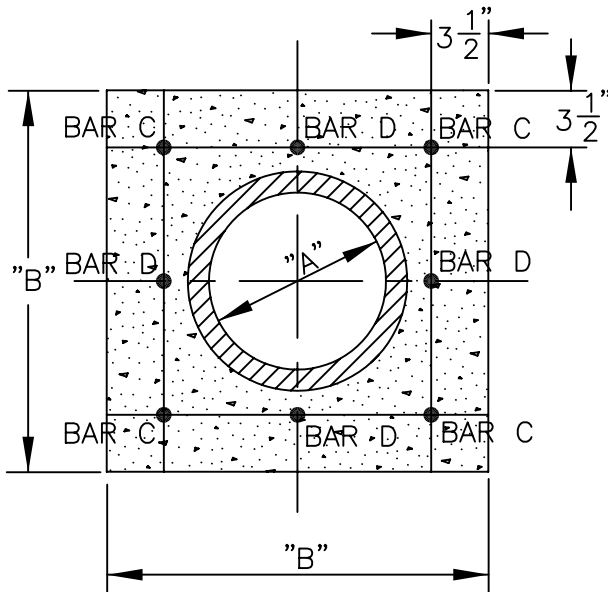
1. ALL CONCRETE SHALL BE 3,000 psi
28 DAY COMPRESSIVE STRENGTH, WITH
2" TO 4" SLUMP.

2. ANCHOR WALLS MUST BE USED
WITH PIPES WITH SLOPES OVER 20%.
ANCHOR WALLS TO BE EQUALLY
SPACED. PROPORTION SPACING WITH
SLOPE.

PIPE SLOPE	WALL SPACING
20%	21'
100%	12'
> 100%	NOT ALLOWED

3. PLACE WALL IMMEDIATELY BELOW BELL
OF PIPE WHERE POSSIBLE.

DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. <i>[Signature]</i>
			SEWER PIPE ANCHOR WALL	DWG. NO. 321




VERTICAL SECTION

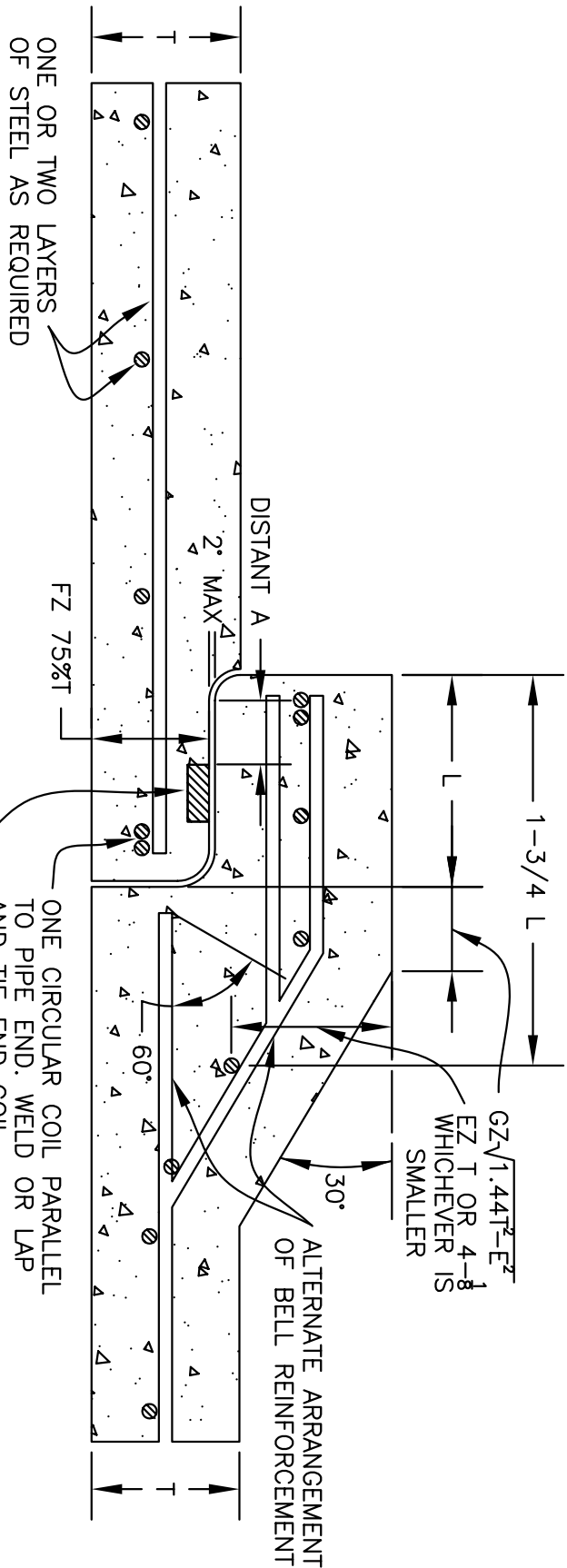
DIMENSIONS—IN.		BARS REQ'D.
"A"	"B"	
6"	16"	C
8"	19"	C
10"	21"	C
12"	23"	C
15"	26 ¹ / ₂ "	C
18"	30 ¹ / ₂ "	C
21"	39"	C&D
24"	43"	C&D
27"	50"	C&D

NOTES:

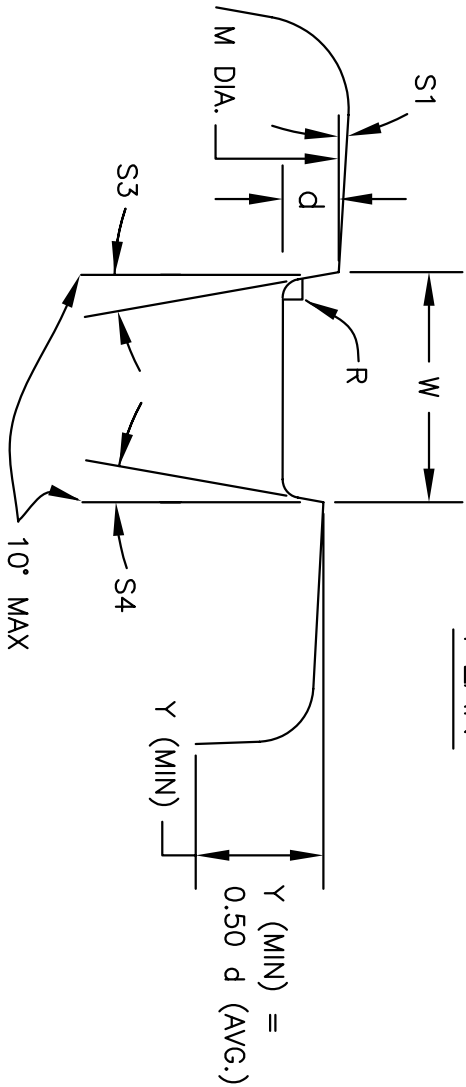
1. ALL CONCRETE SHALL BE 3,000
PSI, 3" TO 5" SLUMP.

2. STEEL REINFORCING SHALL BE NO. 5^Ø IN
CONFORMANCE WITH ASTM A 615, GRADE
60, WITH DEFORMATIONS PER ASTM A 305.

DRAWN DLS			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE NTS
DIV.				DATE JAN 1, 2006
REV.	DATE	APPR.		APPR. 
			SEWER PIPE CONCRETE ENCASEMENT	DWG. NO. 322



PLAN

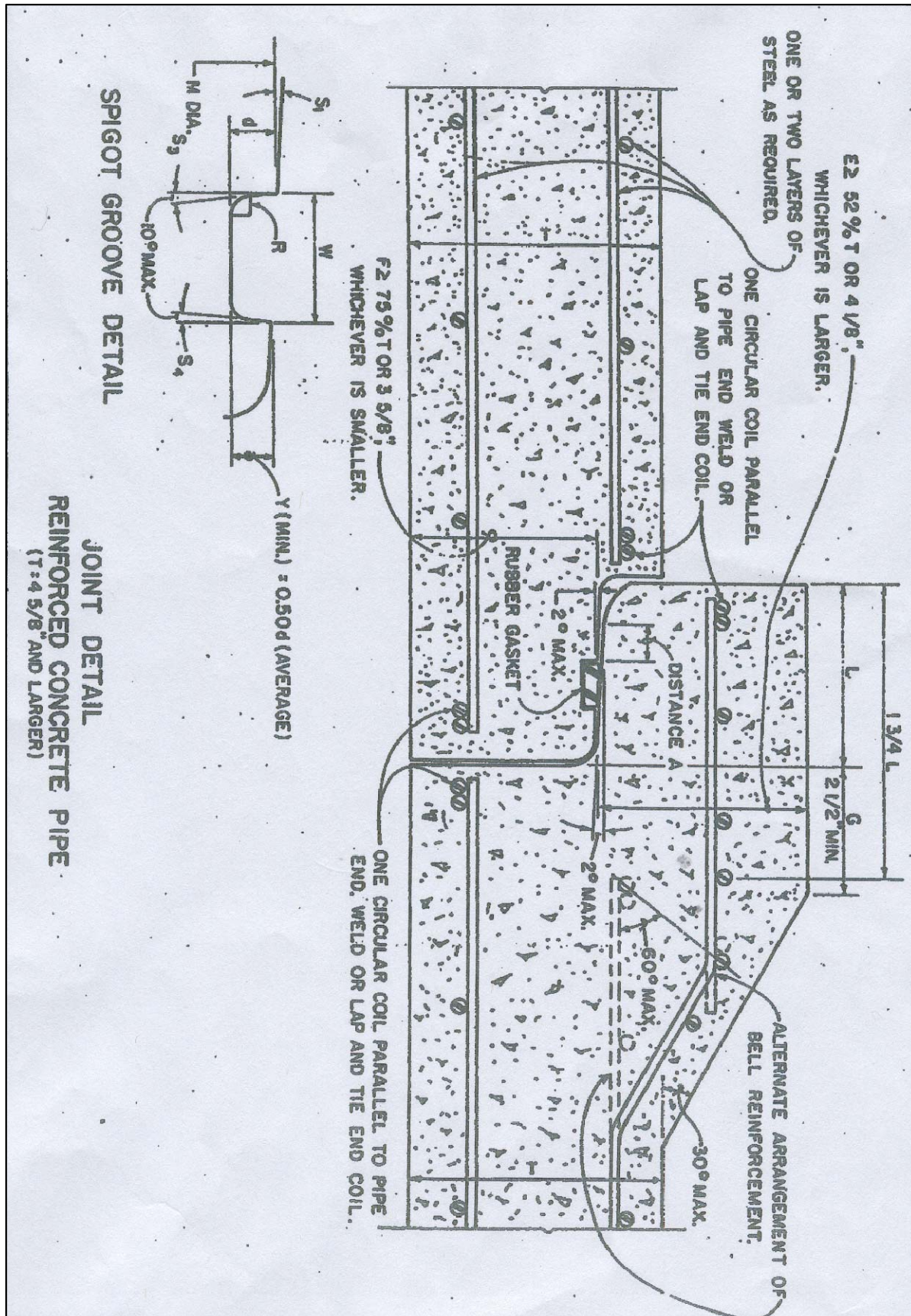


SIGOT GROOVE DETAIL

DRAWN:	DLS
DIV.	
REV.	DATE APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
JOINT DETAIL
REINFORCED CONCRETE (T=4 5/8" AND LARGER)

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>OR</i>
DWG. NO.	323



DRAWN	DLS
DIV.	
REV.	DATE APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
JOINT DETAIL
REINFORCED CONCRETE PIPE (T=4 3/8" AND LARGER)

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	324

PIPE DIAMETER	JOINT TYPE	DIMENSIONS											
		GROOVE WIDTH (W)		R		d		M (DIAMETER)		N (DIAMETER)			
		MINIMUM	MAXIMUM			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46	47	48	49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80				

JOINT CLEARANCE		SLOPE DEGREES				RUBBER GASKET			G	H	J	MAX HEAD CLASS
MINIMUM	MAXIMUM	S1	S2	S3	S4	DESIGN	DESIGN	MINMAX				
1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26
27	28	29	30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49	50	51	52
53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68	69	70	71	72	73	74	75	76	77	78

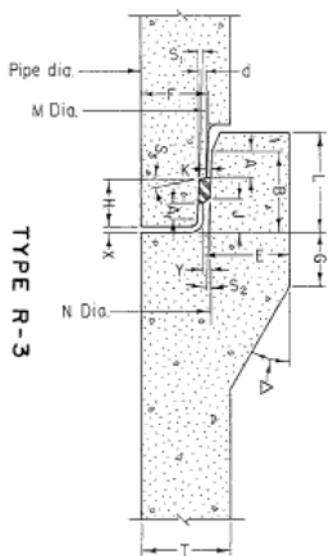
Δ DEG.	A	A ₁	B	C	E	F	T	L	X	Y
1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80								

NOTES

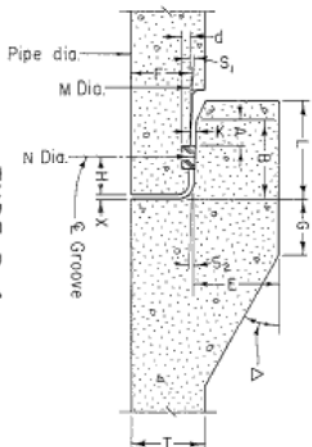
Contractor shall submit all information required by the above tables, unless a dimension shown in the tables is not applicable to the specific type of pipe joint furnished, in which case it shall be left blank.

All dimensions shall be given in inches, unless otherwise noted, and are for bell and spigot in concentric position.

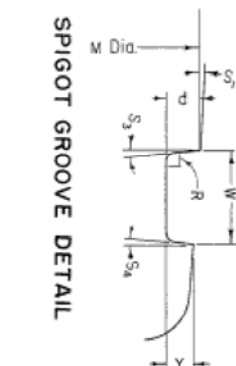
Joint clearance dimension K is at closest point within distance A.



TYPE R-1



TYPE R-4



SPIGOT GROOVE DETAIL

TYPE R-3

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

JOINT DATA FORM
PIPE DIAMETER _____ INCHES
MANUFACTURER _____

SPECIFICATIONS NO. _____
DATE _____

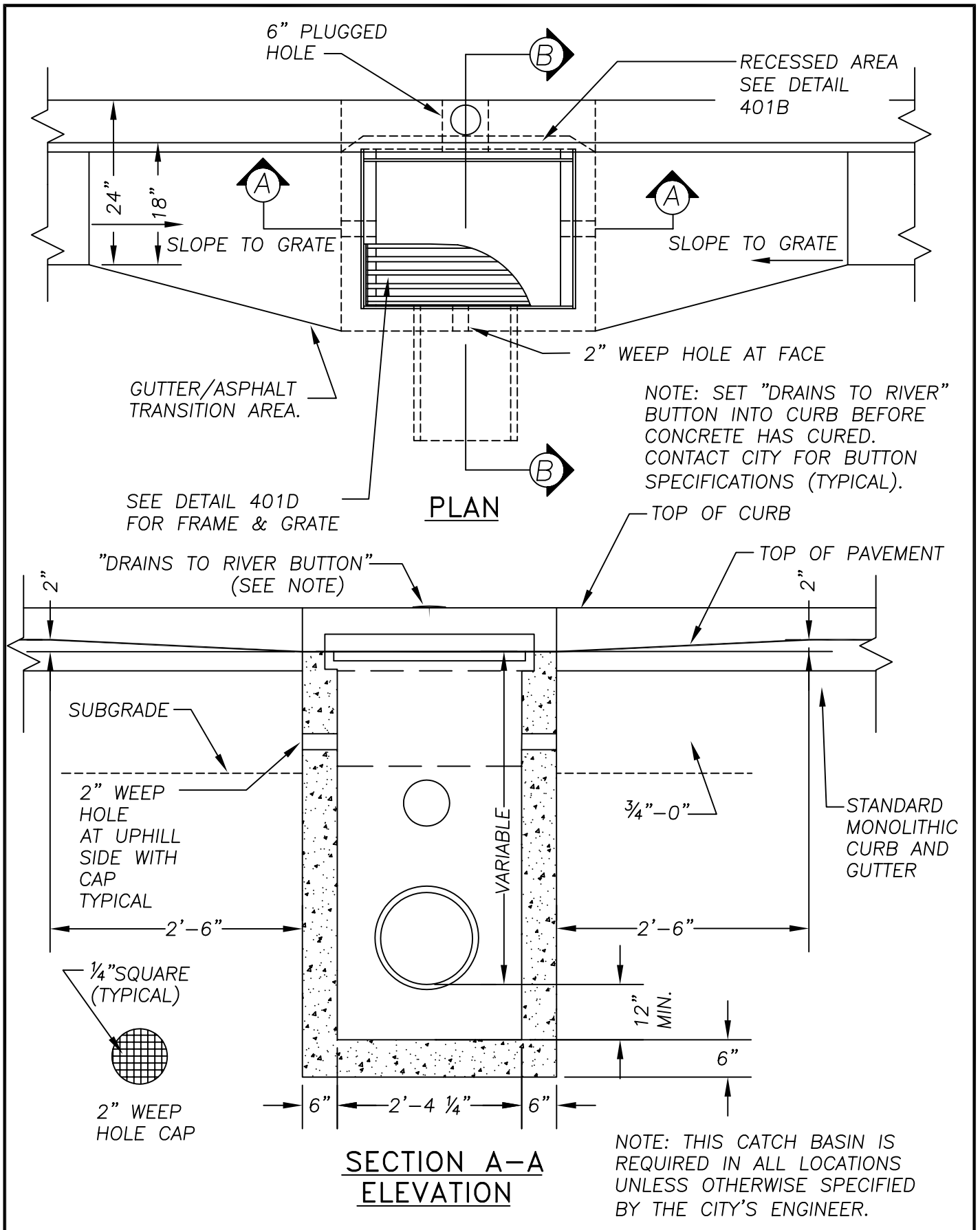
MANUFACTURER'S NUMBER _____


DRAWN:	TNP
DIV.	STORMWATER/WASTEWATER
REV.	DATE
	APPR.

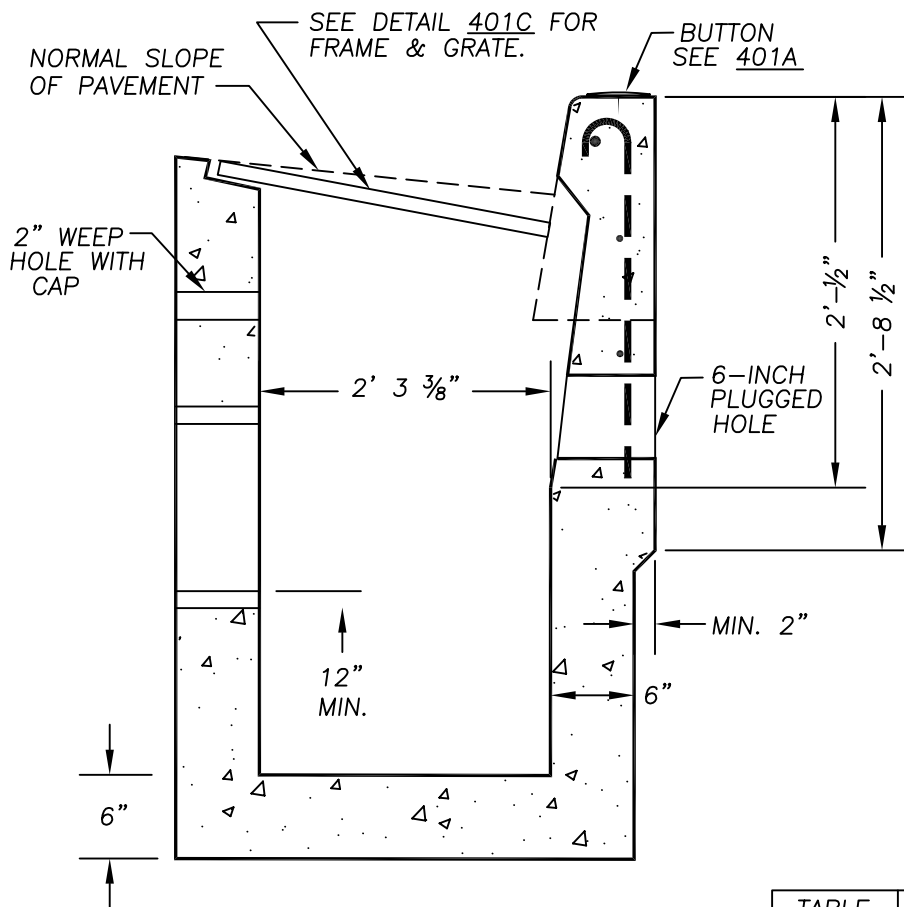
DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

TYPICAL JOINT DETAIL AND DATA FORM

SCALE	NTS
DATE	JAN 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	325



DRAWN			TNP			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030			SCALE		N.T.S.	
DIV.			STORMWATER						DATE		JAN.1,2006	
REV.	DATE	APPR.	CATCH BASIN (1)						APPR.			
									DWG. NO.		401A	



NOTES:

1. INSTALL 6" DRAIN PIPE SUCH THAT THE TOP OF PIPE IS 6" BELOW GRATE OR ALIGNED WITH THE CROWN OF THE OUTLET WHICH EVER IS LESS.
2. IF CATCH BASIN WILL BE PART OF A DRIVEWAY WING, SLANT THE REBAR CAGE AND INLET FORM TO THE SLOPE OF THE TOP OF CURB IN THE WING WHEN POURING THE CATCH BASIN. MAINTAIN THE "Y2" DIMENSION AND DECREASE THE INLET AS NEEDED.
3. IF THE DISTANCE FROM TOP OF CURB TO THE GRATE IS EQUAL TO OR LESS THAN "Y2" NO CURB INLET IS REQUIRED.
4. #3 BARS SHALL BE PLACED DURING CURB CONSTRUCTION.
5. ALL BARS SHALL BE PLACED 1 1/2" CLEAR OF NEAREST FACE OF CONCRETE UNLESS SHOWN OR OTHERWISE NOTED.
6. ALL BAR SPLICE LENGTHS SHALL BE A MIN. 20".
7. CLASS 3300 CONCRETE SHALL BE USED IN ALL INLET CONSTRUCTION.

SECTION B-B

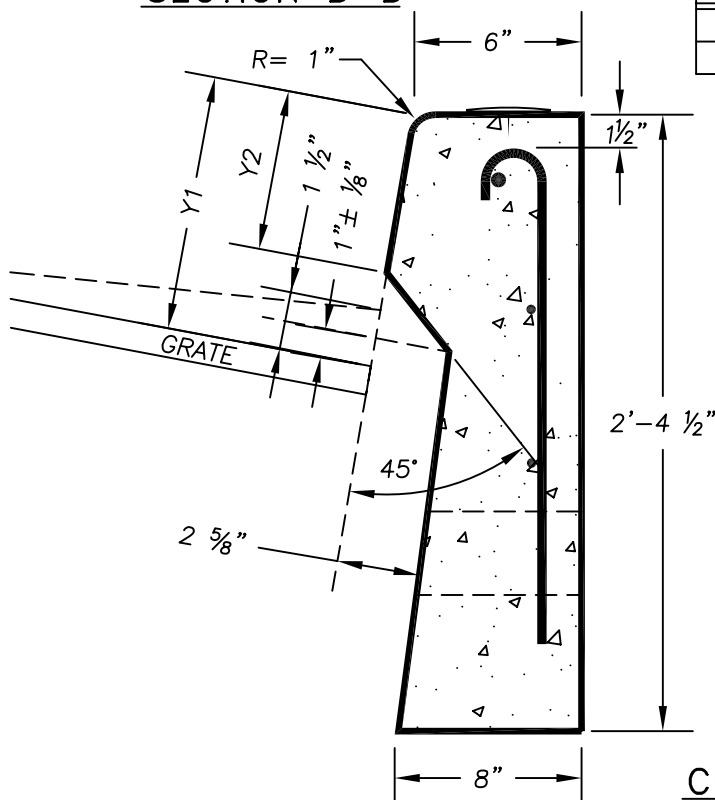
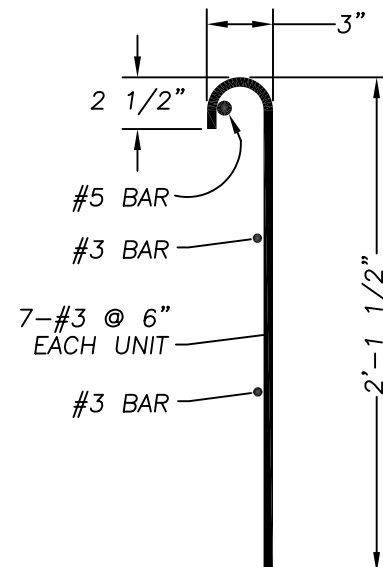


TABLE 601-C	CURB TYPE	
	TYPE "C"	MONOLITHIC
Y1	8 1/2"	7 1/2"
Y2	5 3/4"±	4 3/4"±

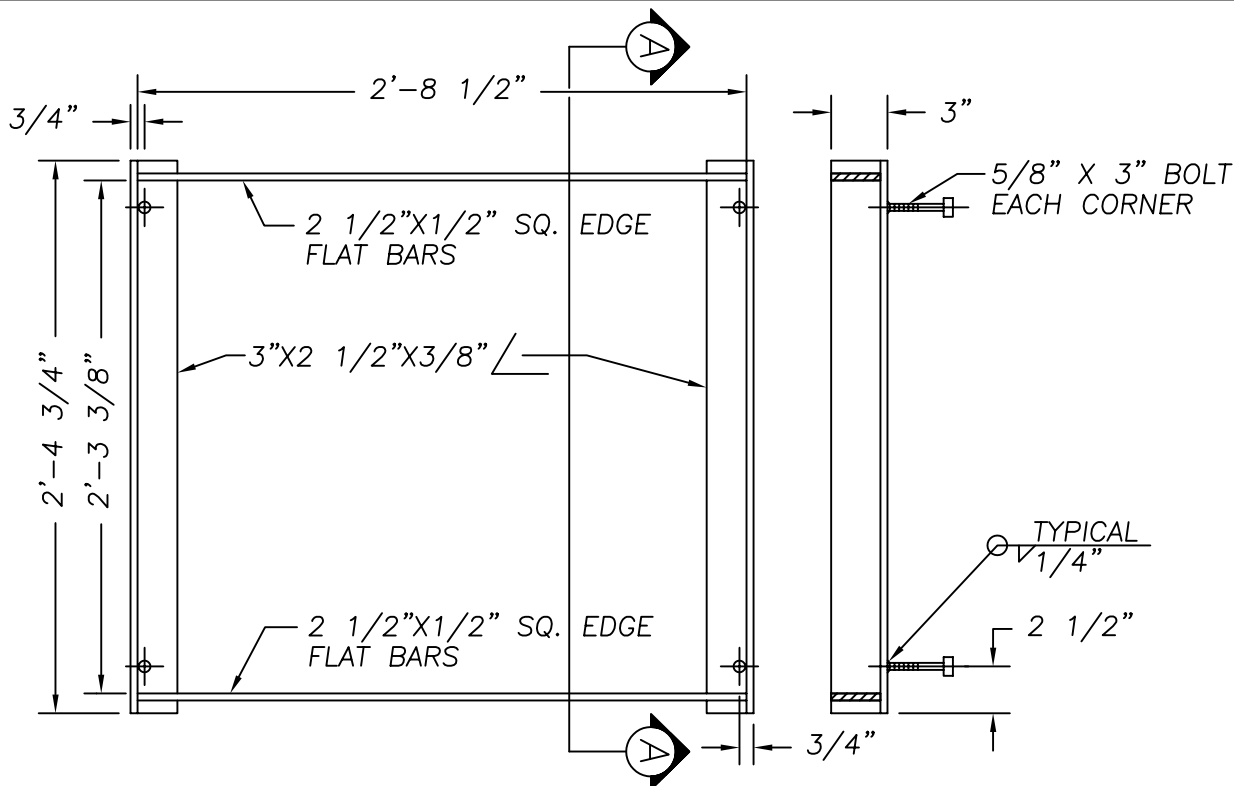


CURB DETAIL AT CATCH BASIN

DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
CATCH BASIN SECTION (1)		

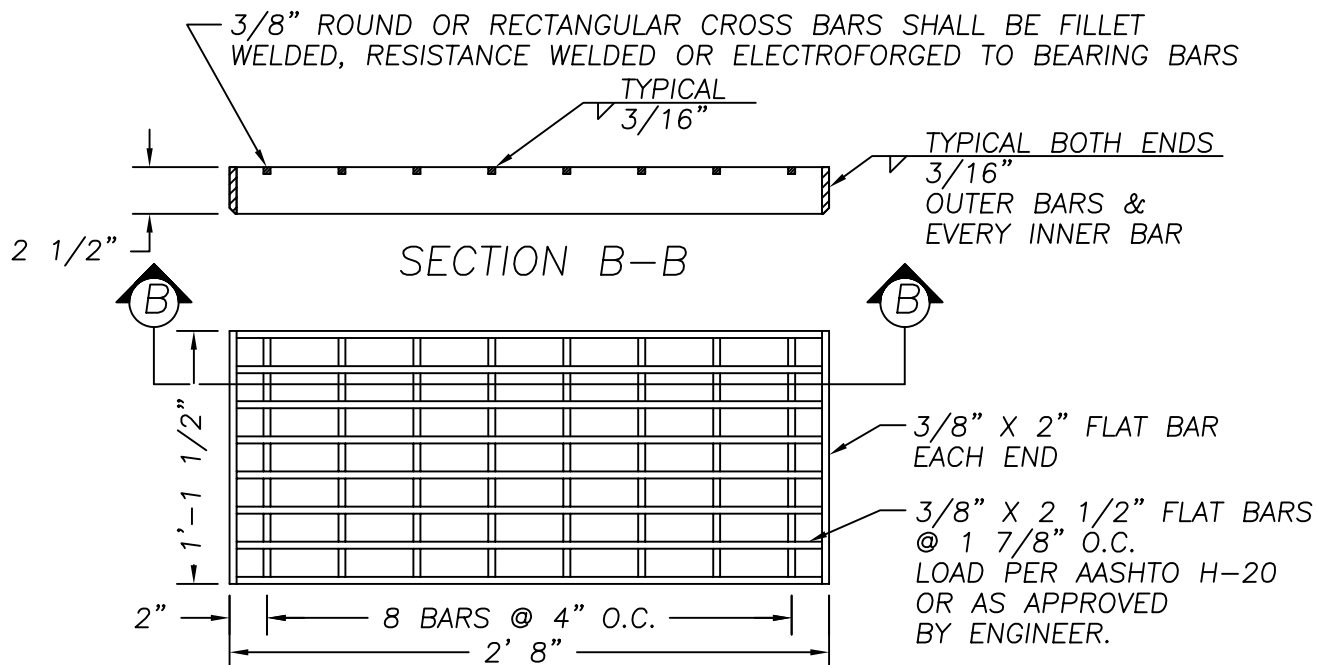
SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>OR</i>
DWG. NO.	401B



NOTE:
USE VERTICAL BEADS IN CORNERS, FILLET WELD JOINT ON
BOTTOM OF FRAME. GRATE MUST REST FLAT ON FRAME SURFACE.

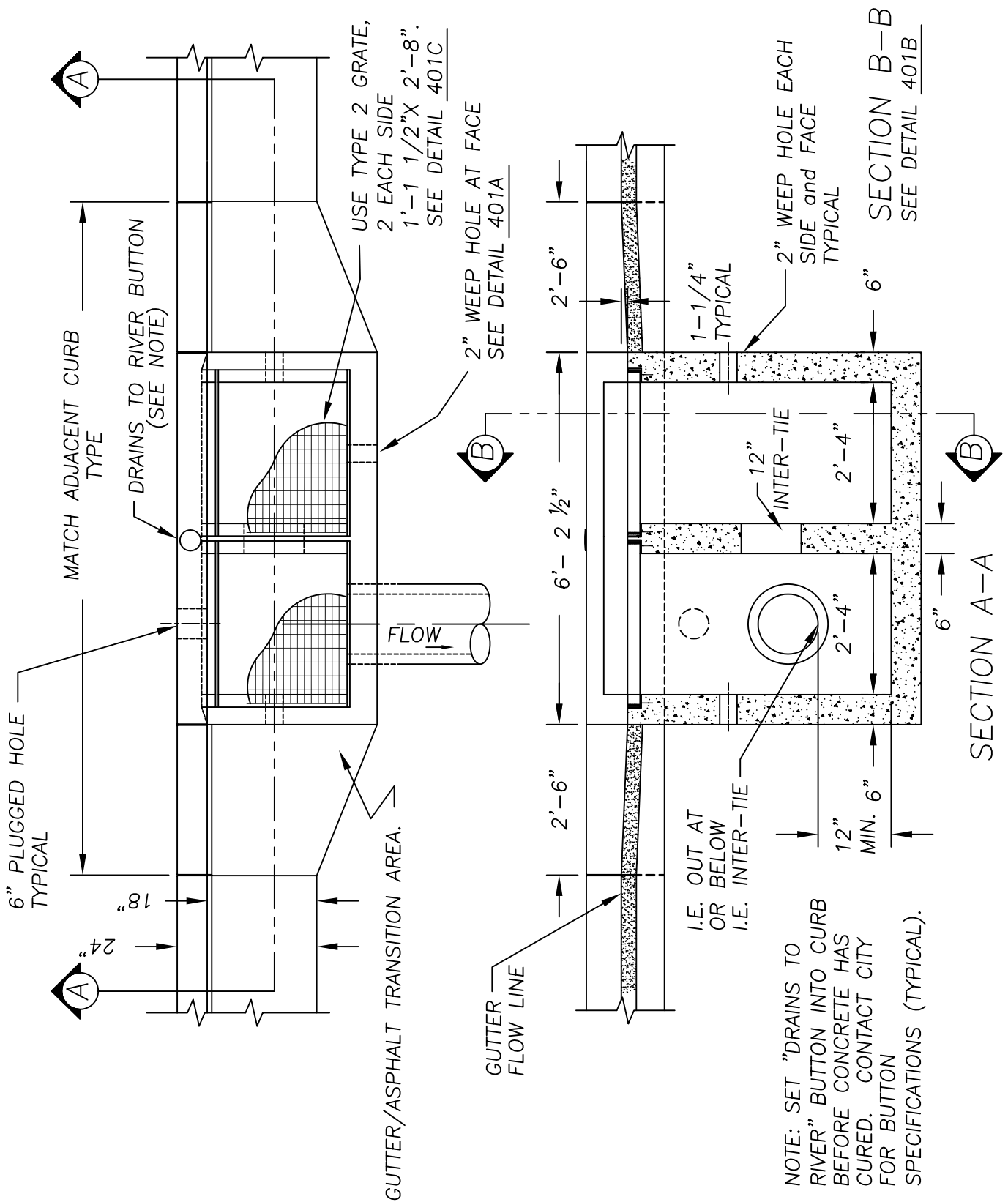
PLAN (FRAME)

SECTION A-A



PLAN (GRATE)
TYPE 2 GRATE

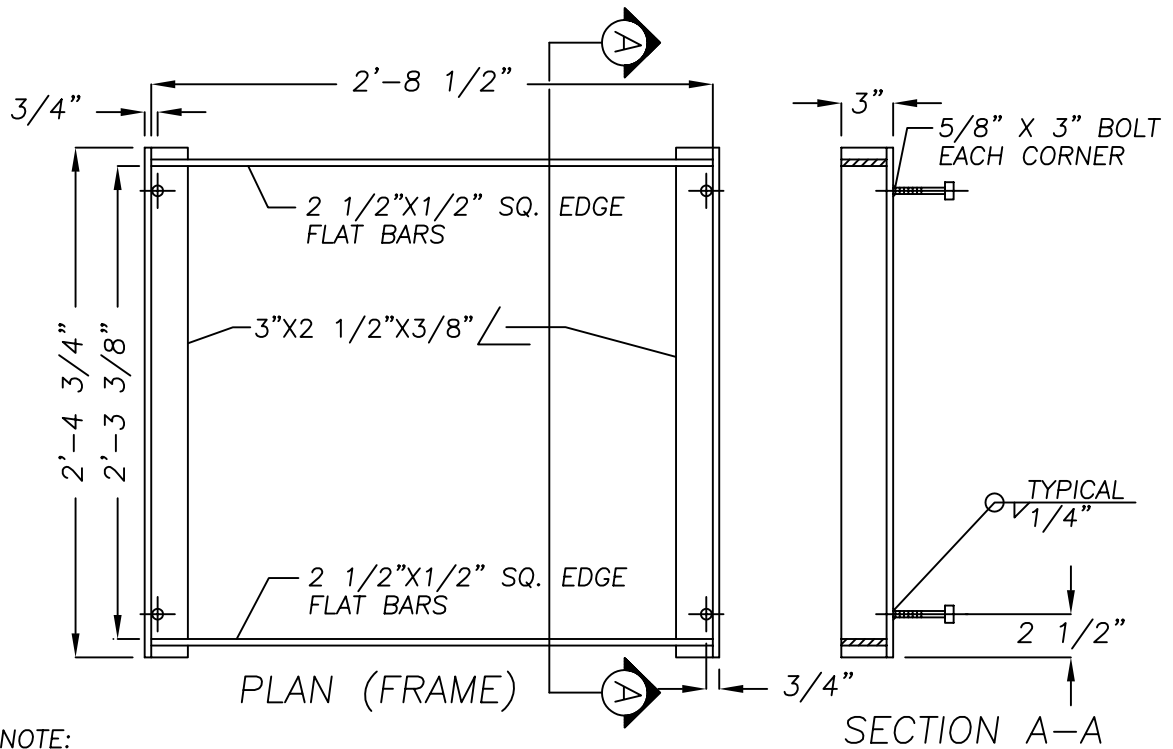
DRAWN	RRB	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 CATCH BASIN FRAME AND GRATE (1)		SCALE	N.T.S.
DIV.	STORMWATER			DATE	JAN. 1, 2006
REV.	DATE			APPR.	<i>[Signature]</i>
				DWG. NO.	401C



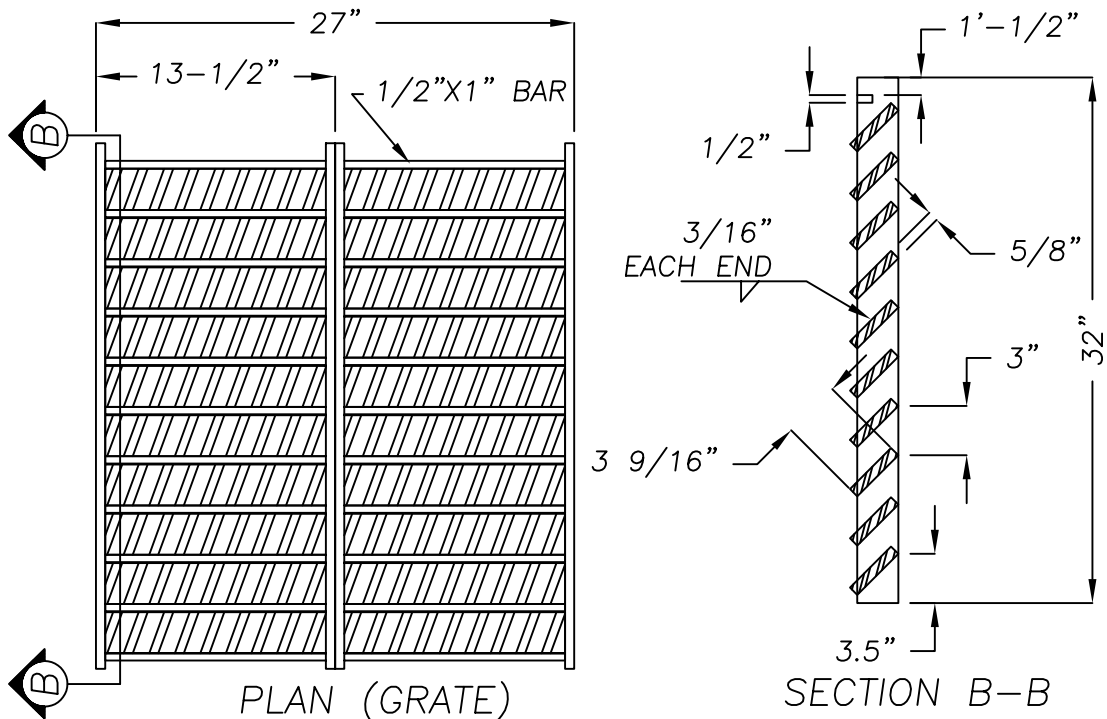
DRAWN RRB		
DIV. STORMWATER		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
DOUBLE CATCH BASIN (1)

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OR</i>
DWG. NO.	401D

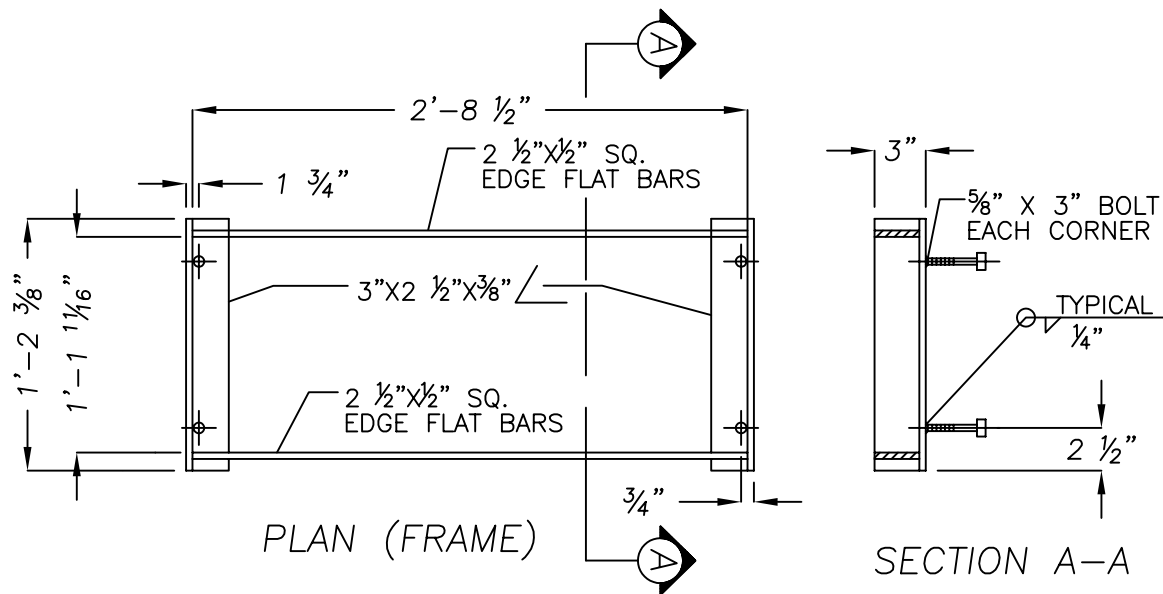


NOTE:
USE VERTICAL BEADS IN CORNERS, FILLET WELD JOINT ON
BOTTOM OF FRAME. GRATE MUST REST FLAT ON FRAME SURFACE.
BAR SIZE PER AASHTO LOAD REQUIREMENTS AND AS APPROVED BY ENGINEER.



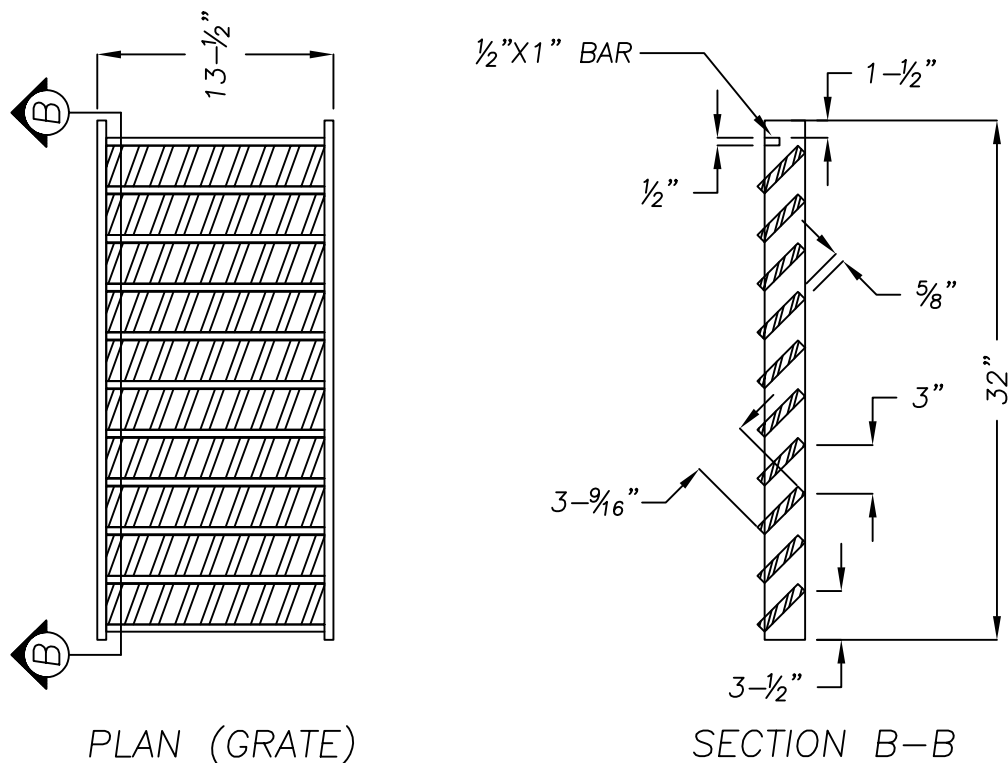
NOTE: THIS GRATE MAY BE REQUIRED IN HILLSIDE AREAS OR
WHERE STREET SLOPES EXCEED 5 PERCENT GRADE, OR
WHERE THE CATCH BASIN FRAME AND GRATE (1) IS NOT CAPABLE OF
INTERCEPTING COMPLETELY THE DESIGN STORM FLOW AT THE CURB.

DRAWN	TNP	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 CATCH BASIN (1) WITH P-45 GRATE		SCALE	N.T.S.
DIV.	STORMWATER			DATE	JAN. 1,2006
REV.	DATE			APPR.	<i>[Signature]</i>
				DWG. NO.	401E




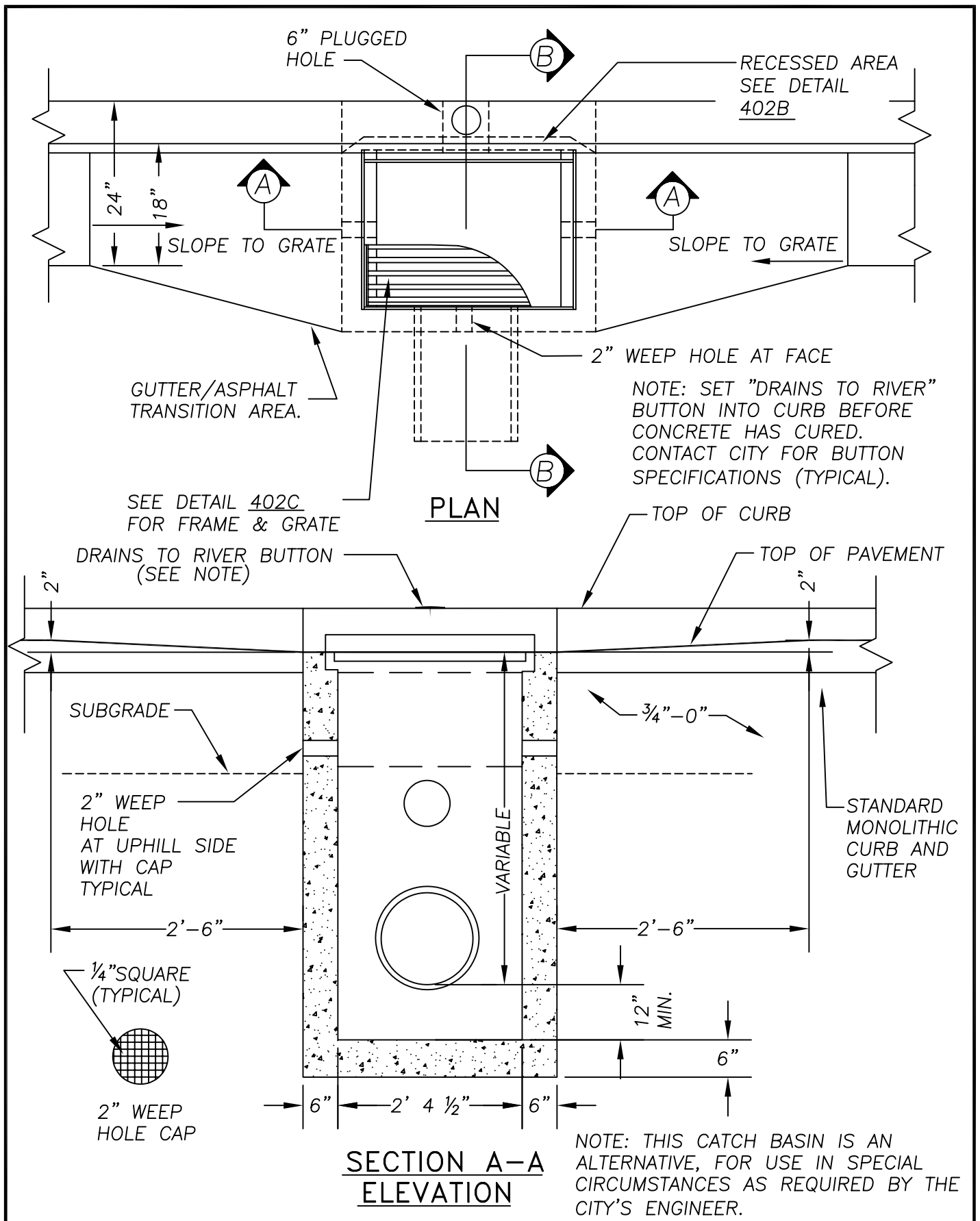
NOTE:

USE VERTICAL BEADS IN CORNERS, FILLET WELD JOINT ON BOTTOM OF FRAME. GRATE MUST REST FLAT ON FRAME SURFACE. BAR SIZE PER AASHTO LOAD REQUIREMENTS AND AS APPROVED BY ENGINEER.



NOTE: THIS GRATE MAY BE REQUIRED IN HILLSIDE AREAS OR WHERE STREET SLOPES EXCEED 5 PERCENT GRADE, OR WHERE THE CATCH BASIN FRAME AND GRATE (1) IS NOT CAPABLE OF INTERCEPTING COMPLETELY THE DESIGN STORM FLOW AT THE CURB.

DRAWN			TNP			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030			SCALE			N.T.S.		
DIV.			STORMWATER						DATE			JAN. 1, 2006		
REV.			DATE			APPR.			APPR.					
									MODIFIED CATCH BASIN (1)			DWG. NO. 401F		
									FRAME WITH SINGLE P-45 GRATE					



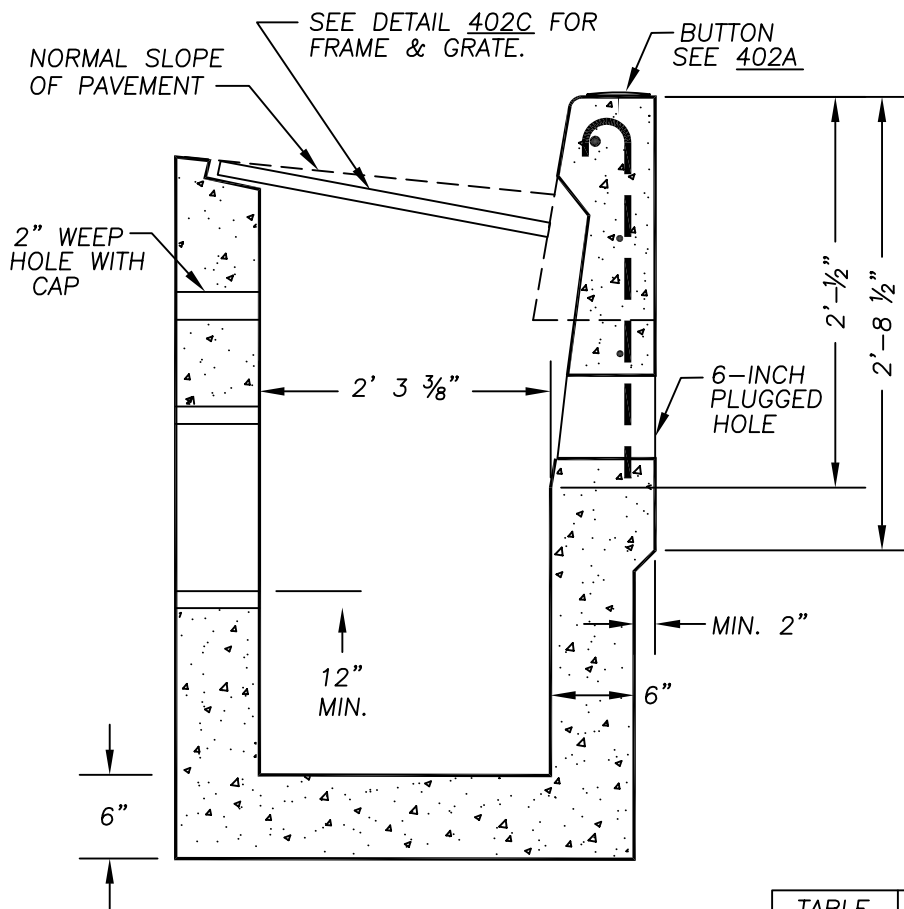
DRAWN		TNP	
DIV.		STORMWATER	
REV.	DATE	APPR.	

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

CATCH BASIN (2)

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	402A



NOTES:

1. INSTALL 6" DRAIN PIPE SUCH THAT THE TOP OF PIPE IS 6" BELOW GRATE OR ALIGNED WITH THE CROWN OF THE OUTLET WHICH EVER IS LESS.
2. IF CATCH BASIN WILL BE PART OF A DRIVEWAY WING, SLANT THE REBAR CAGE AND INLET FORM TO THE SLOPE OF THE TOP OF CURB IN THE WING WHEN POURING THE CATCH BASIN. MAINTAIN THE "Y2" DIMENSION AND DECREASE THE INLET AS NEEDED.
3. IF THE DISTANCE FROM TOP OF CURB TO THE GRATE IS EQUAL TO OR LESS THAN "Y2" NO CURB INLET IS REQUIRED.
4. #3 BARS SHALL BE PLACED DURING CURB CONSTRUCTION.
5. ALL BARS SHALL BE PLACED 1 1/2" CLEAR OF NEAREST FACE OF CONCRETE UNLESS SHOWN OR OTHERWISE NOTED.
6. ALL BAR SPLICE LENGTHS SHALL BE A MIN. 20" DIA.
7. CLASS 3300 CONCRETE SHALL BE USED IN ALL INLET CONSTRUCTION.

SECTION B-B

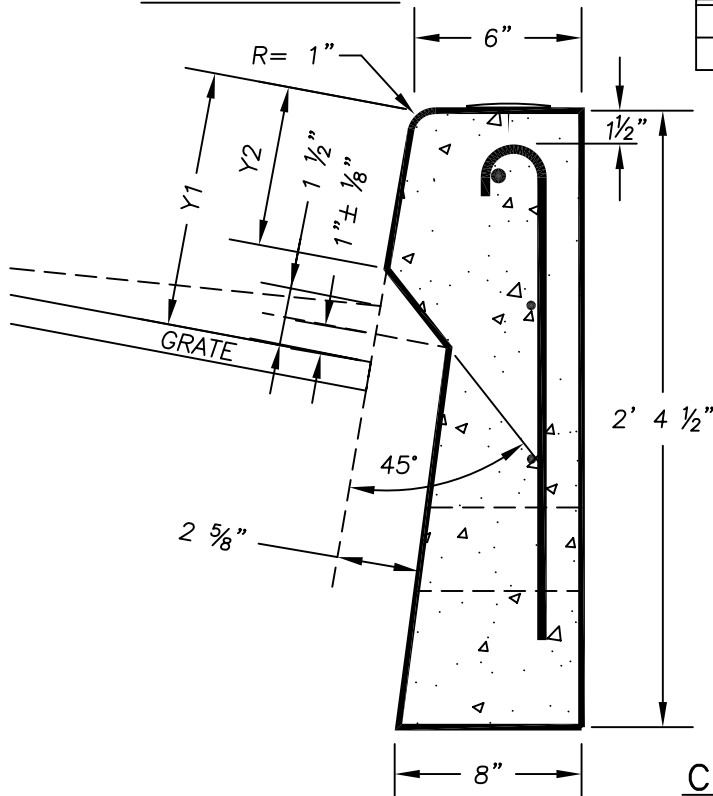
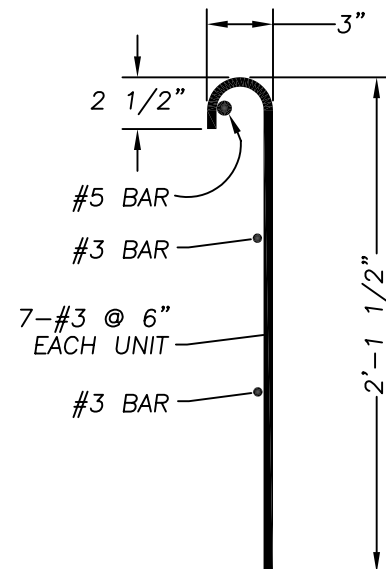


TABLE 601-C	CURB TYPE	
	TYPE "C"	MONOLITHIC
Y1	8 1/2"	7 1/2"
Y2	5 3/4"±	4 3/4"±



CURB DETAIL AT CATCH BASIN

DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

CATCH BASIN SECTION (2)

SCALE N.T.S.

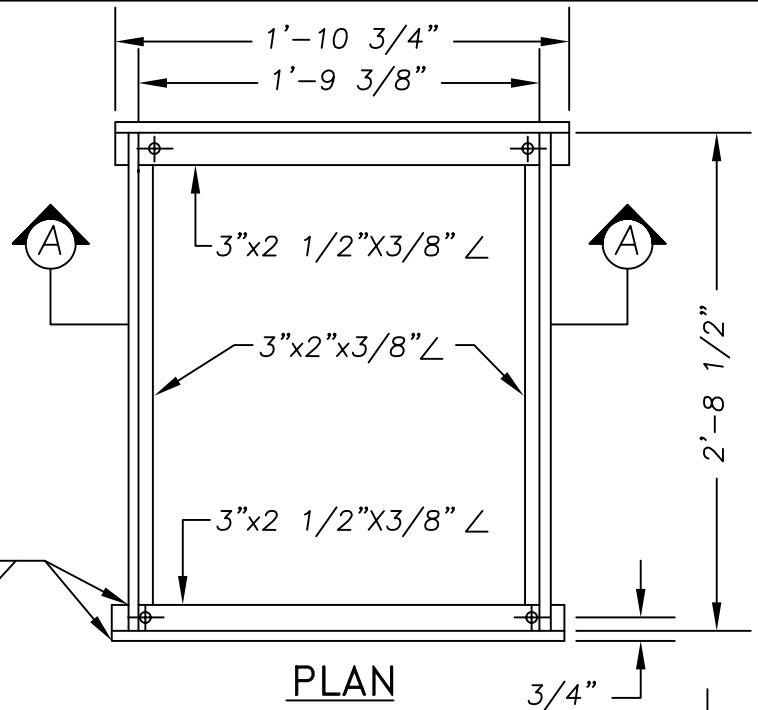
DATE JAN. 1,2006

APPR. *[Signature]*

DWG. NO. 402B

NOTE:
USE VERTICAL BEADS IN CORNERS,
FILLET WELD JOINT ON BOTTOM OF
FRAME. GRATE MUST REST FLAT ON
FRAME SURFACE.

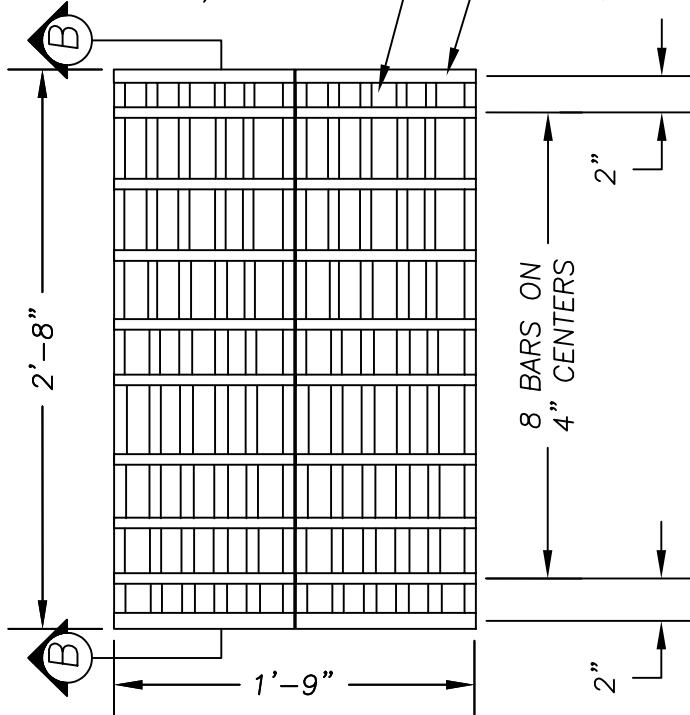
TYP.
3/16"



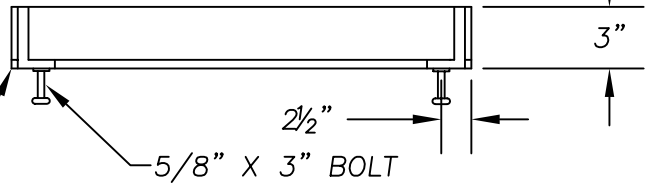
3/8"x2" FLAT BAR EACH END

3/8"x2 1/2" FLAT
7-BARS EACH SIDE
AT 1-3/4" O.C.

TYP.
1/4"

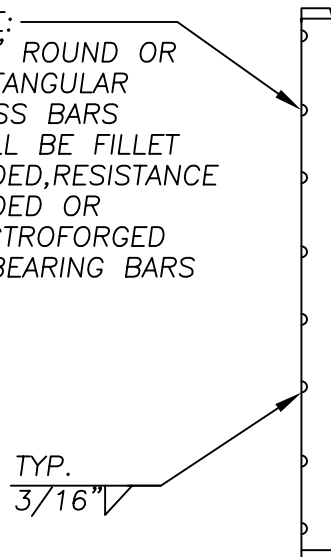


SECTION A-A



NOTE:
3/8" ROUND OR
RECTANGULAR
CROSS BARS
SHALL BE FILLET
WELDED, RESISTANCE
WELDED OR
ELECTROFORGED
TO BEARING BARS

TYP.
3/16"



DRAWN		RRB	
DIV.		STORMWATER	
REV.	DATE		APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

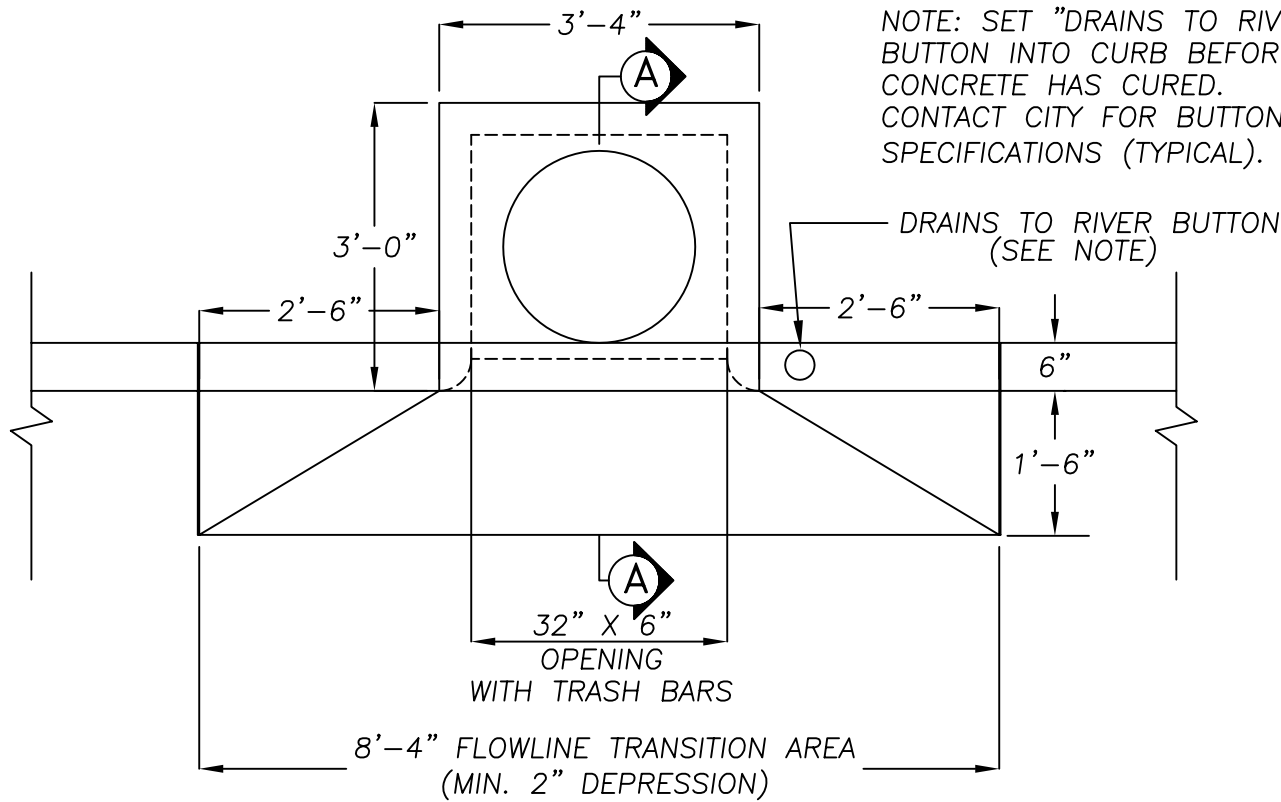
FRAME AND GRATE

SCALE N.T.S.

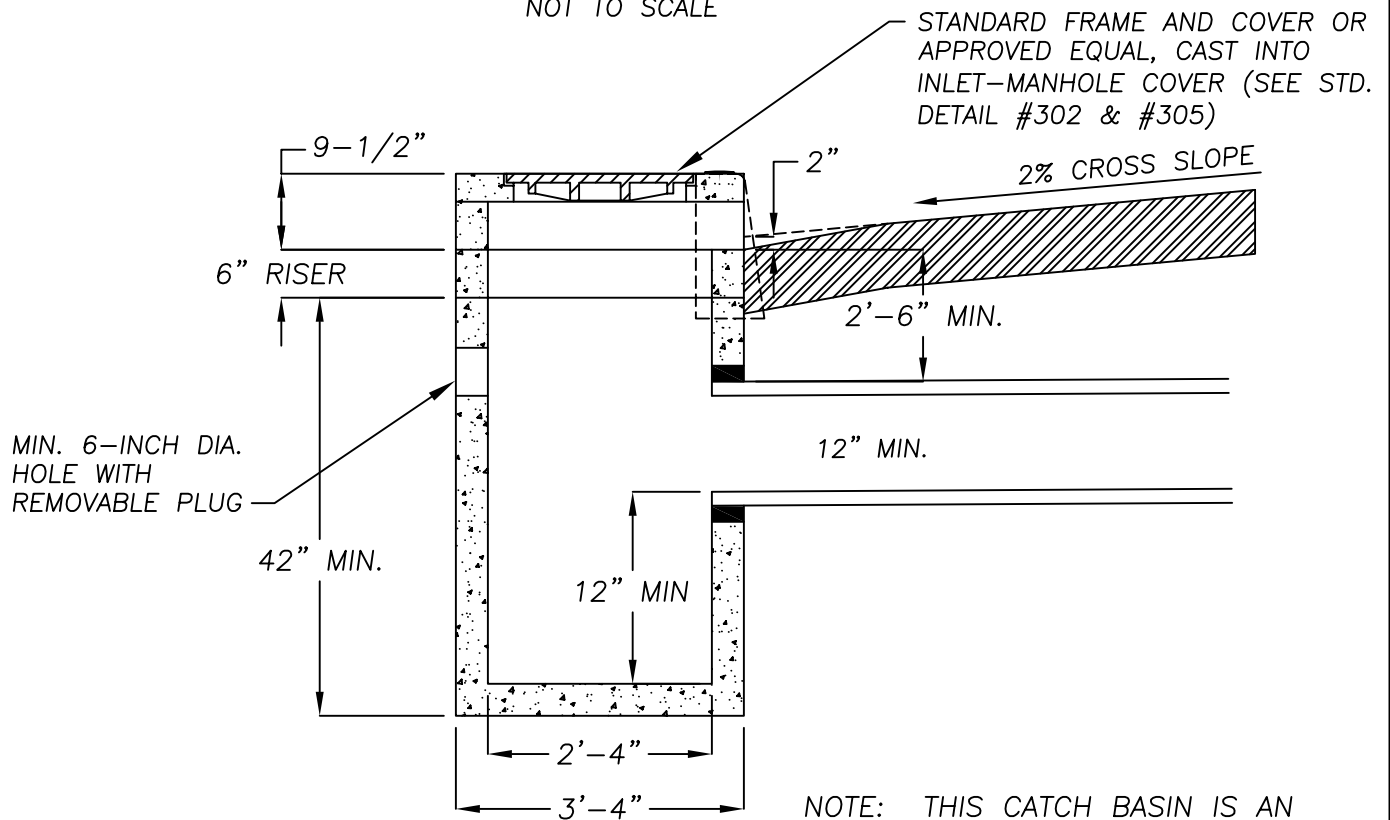
DATE JAN. 1, 2006

APPR. *OR*

DWG. NO. 402C



PLAN
NOT TO SCALE



PROFILE
(SECTION A-A)
NOT TO SCALE

NOTE: THIS CATCH BASIN IS AN ALTERNATIVE, FOR USE IN SPECIAL CIRCUMSTANCES AS REQUIRED BY THE CITY'S ENGINEER.

DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

NON-GRATED CATCH BASIN

SCALE N.T.S.

DATE JAN. 1, 2006

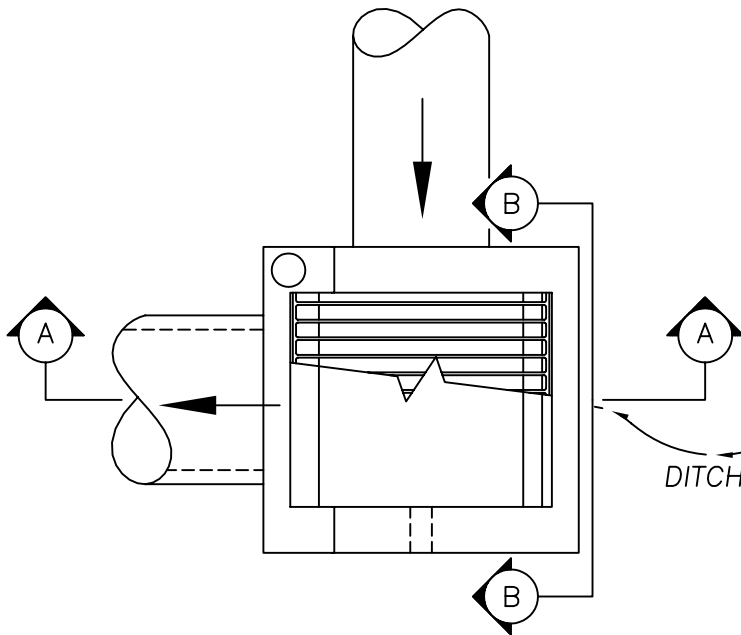
APPR. *[Signature]*

DWG. NO. 403

1. CONCRETE SHALL ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 3300 P.S.I. IN 28 DAYS

2. FOR FRAME & GRATE DETAIL SEE STD. DWG NO. 404B

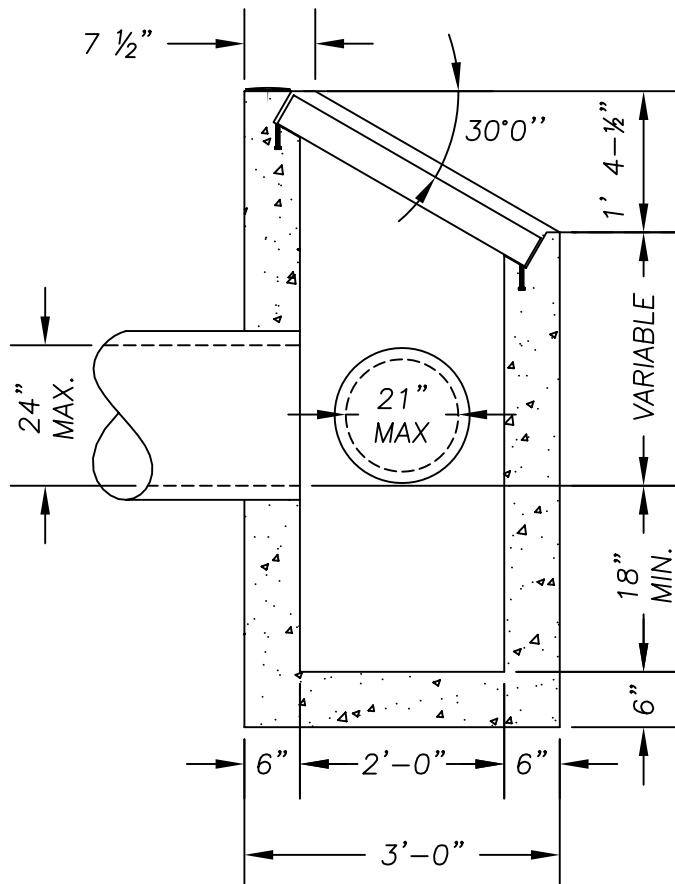
3. WHERE PRECAST INLETS ARE USED AS AN ALTERNATIVE TO CAST IN PLACE INLETS, A 4" COMPACTED LEVELING BED OF $\frac{3}{4}$ "-0" CRUSHED AGGREGATE SHALL BE PROVIDED



DITCH

NOTE: SET "DRAINS TO RIVER" BUTTON INTO CURB BEFORE CONCRETE HAS CURED. CONTACT CITY FOR BUTTON SPECIFICATIONS (TYPICAL).

PLAN

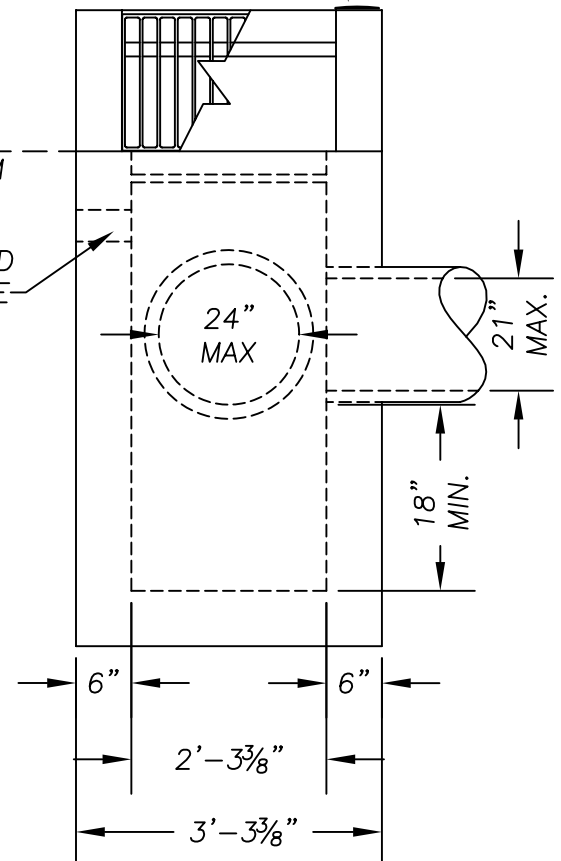


SECTION A-A

DRAINS TO RIVER BUTTON (SEE NOTE)

DITCH BOTTOM

6" PLUGGED HOLE

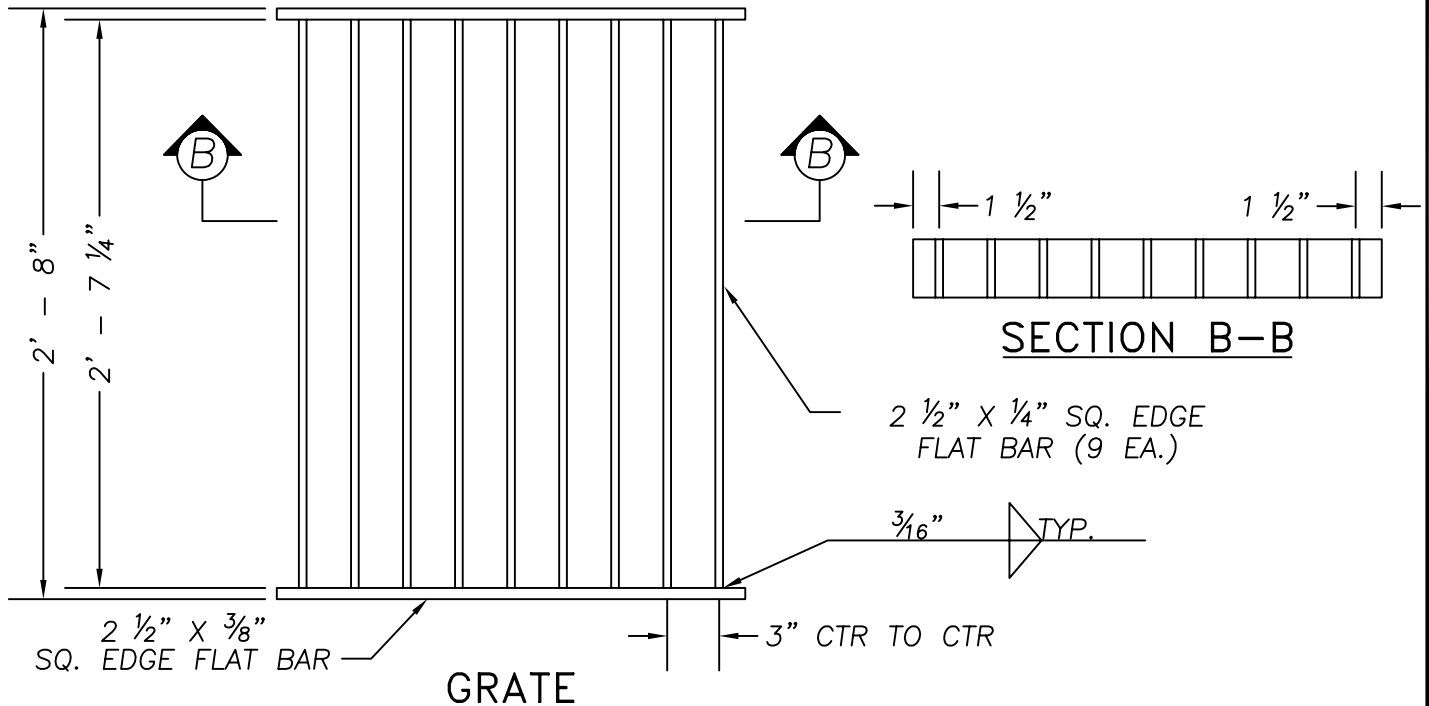
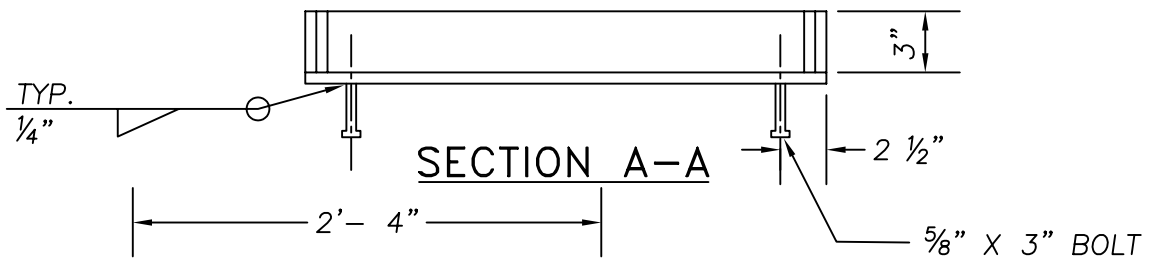
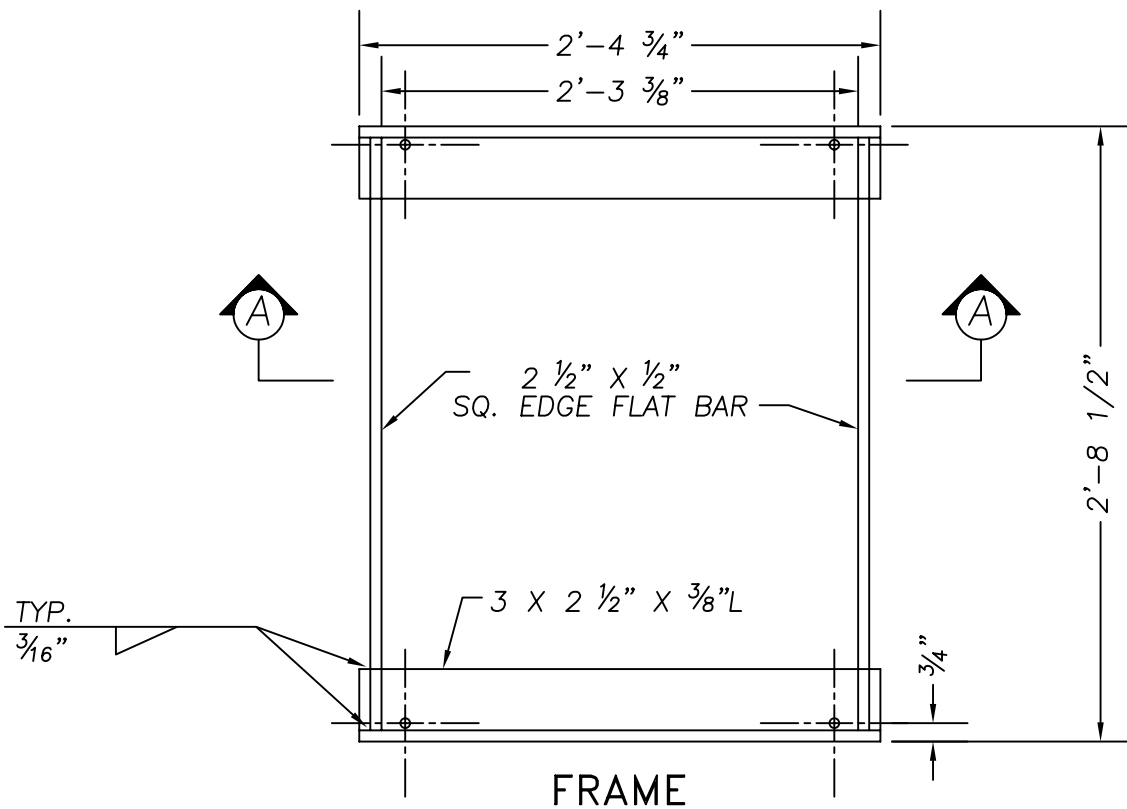


SECTION B-B

DRAWN	TNP
DIV.	STORMWATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
DITCH INLET
TYPE D

SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>[Signature]</i>
DWG. NO.	404A



SECTION B-B

2 1/2" x 1/4" SQ. EDGE
FLAT BAR (9 EA.)

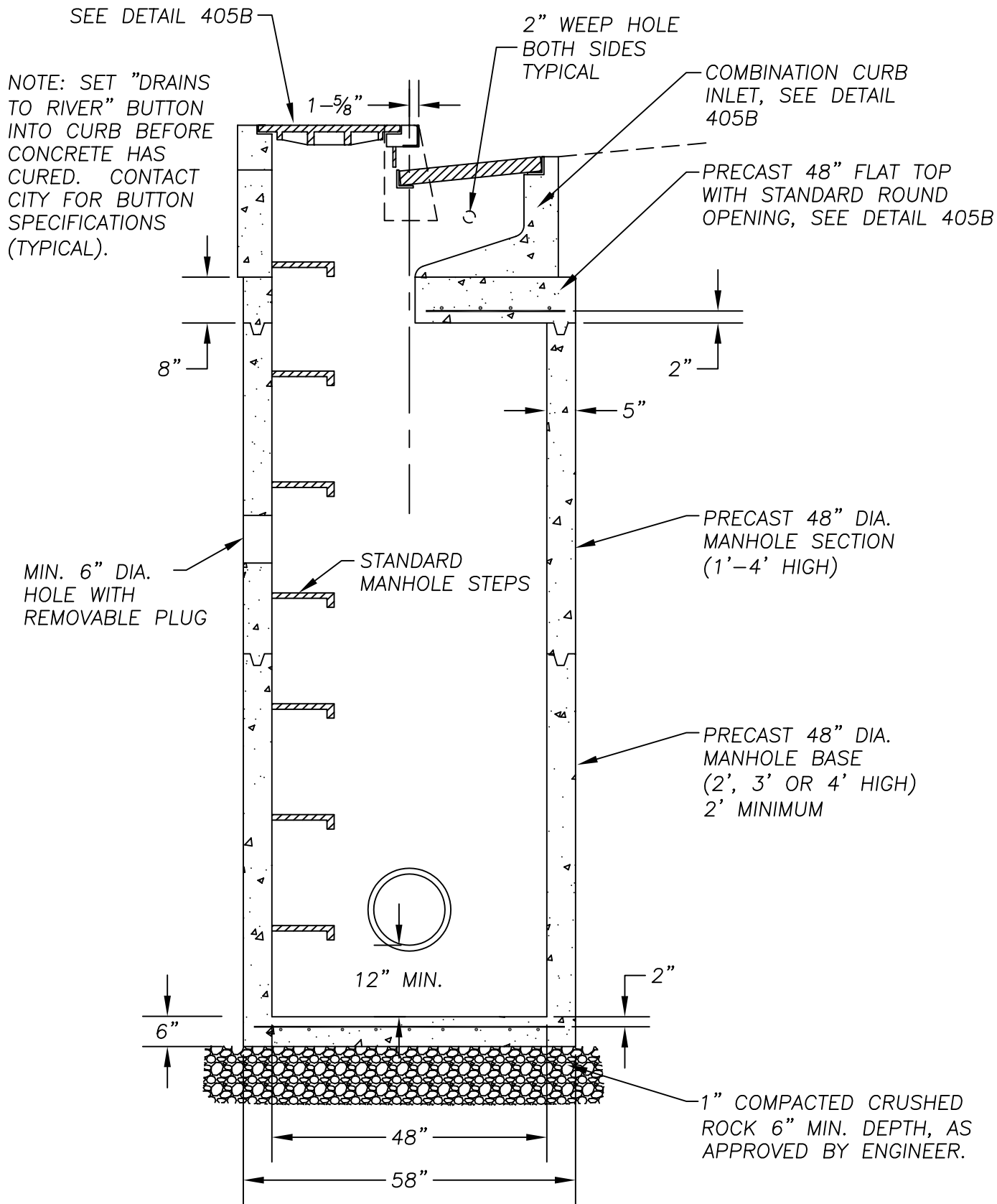
3/16" TYP.

3" CTR TO CTR

DRAWN	TNP
DIV.	STORMWATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
DITCH INLET FRAME & GRATE

SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>OK</i>
DWG. NO.	404B

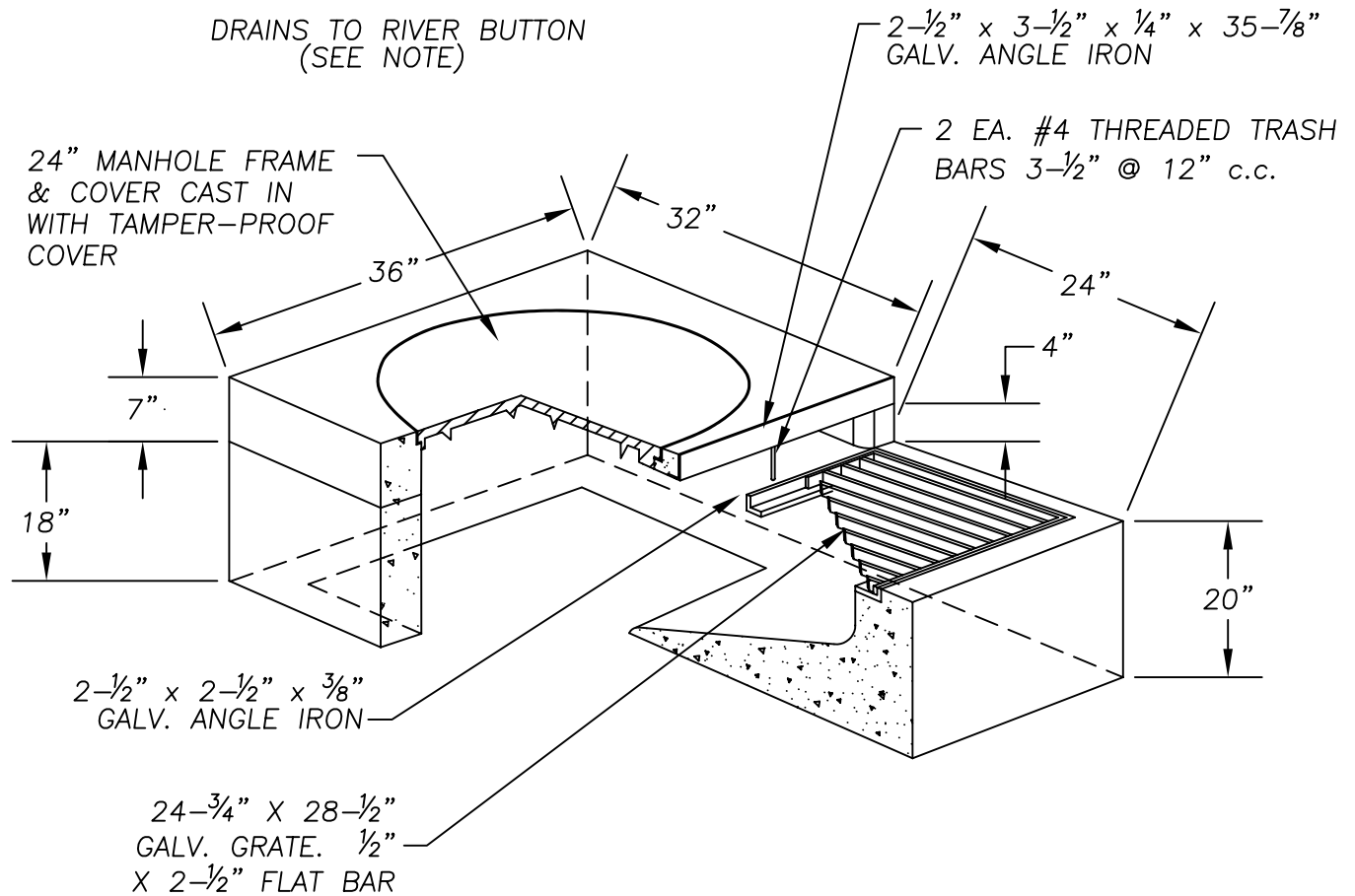


PROFILE

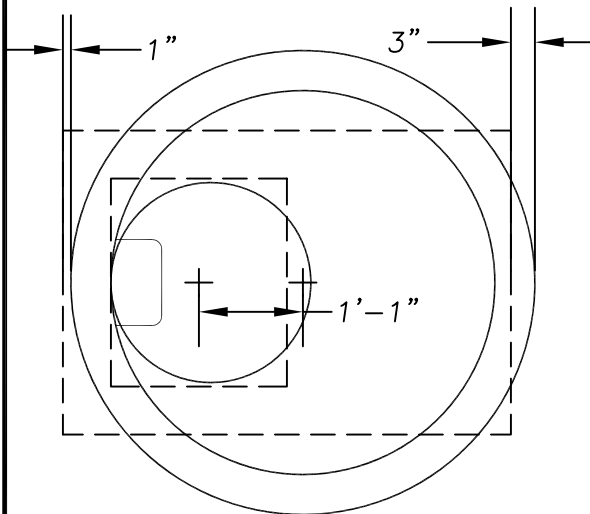
DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
INLET-MANHOLE STANDARD		

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OR</i>
DWG. NO.	405A



COMBINATION CURB INLET



STANDARD FLAT TOP WITH ROUND OPENING

NOTES:


1. REINFORCING FOR INLET UNIT 3 EA. #4 HORIZONTAL BARS.
2. REINFORCING FOR TOP UNIT 2 EA. #3 HORIZONTAL BARS.
3. REINFORCING FOR INLET SLOPED BASE, 4" X 4" MESH.
4. GUTTER IS TAPERED DOWN TO GRATE INLET.
5. SET "DRAINS TO RIVER" BUTTON INTO ADJACENT CURB BEFORE CONCRETE HAS CURED, CONTACT CITY FOR BUTTON SPECIFICATIONS (TYPICAL).

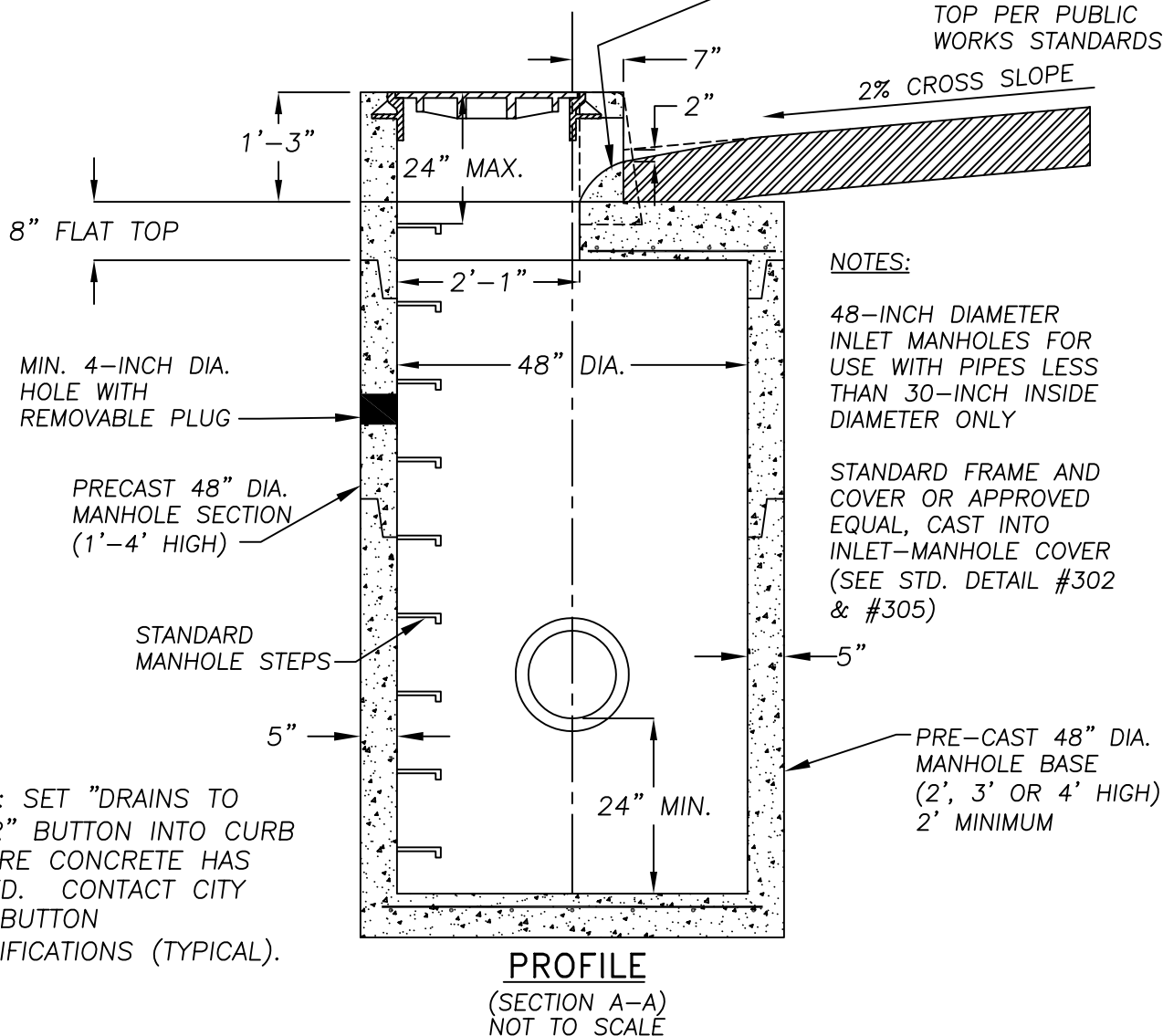
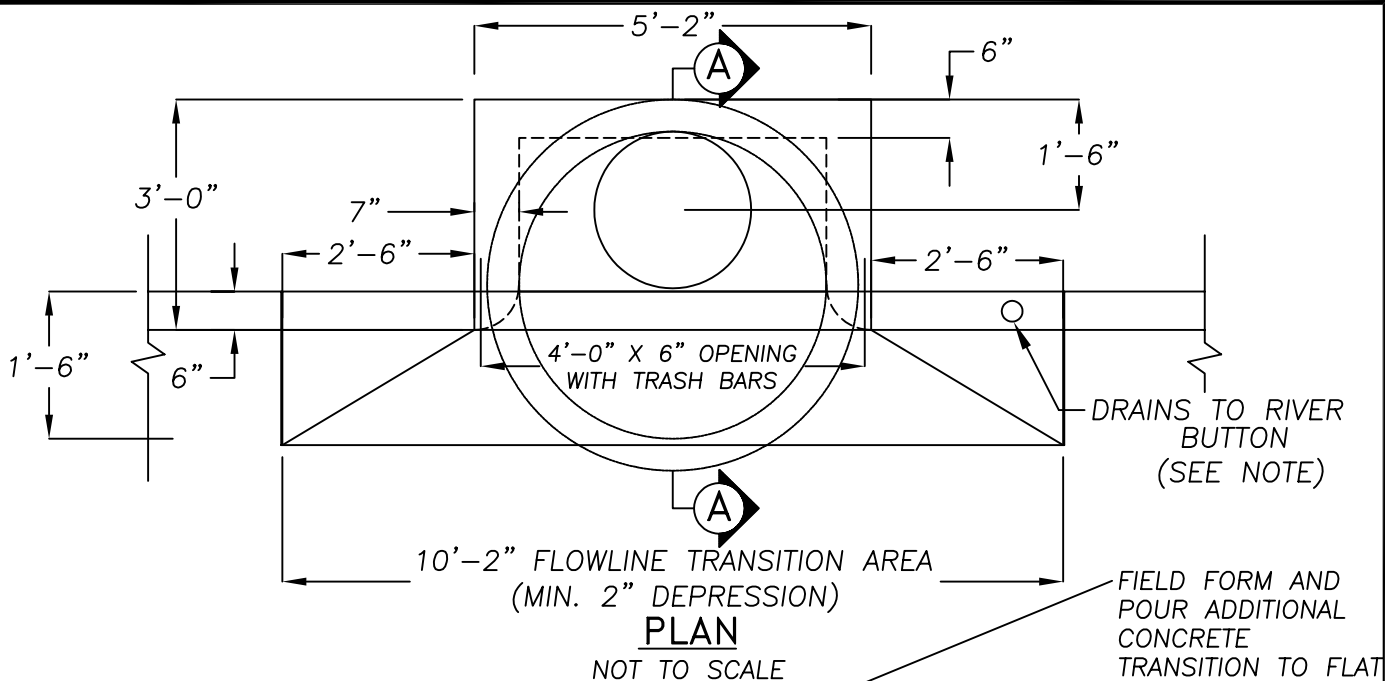
DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
 INLET-MANHOLE COMBINATION CURB INLET

SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>OK</i>
DWG. NO.	405B



SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	
DWG. NO.	405C

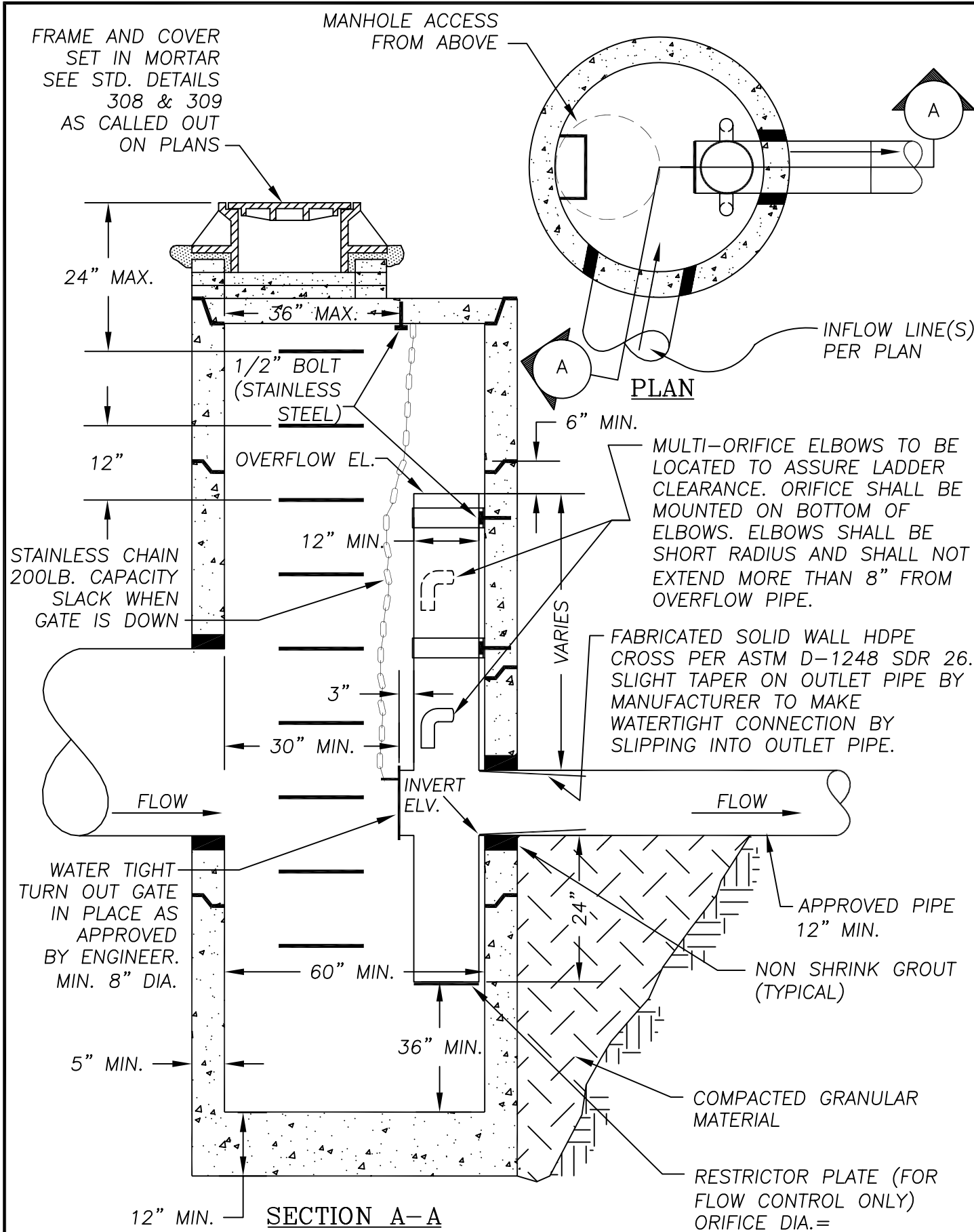


NOTE: SET "DRAINS TO RIVER" BUTTON INTO CURB BEFORE CONCRETE HAS CURED. CONTACT CITY FOR BUTTON SPECIFICATIONS (TYPICAL).

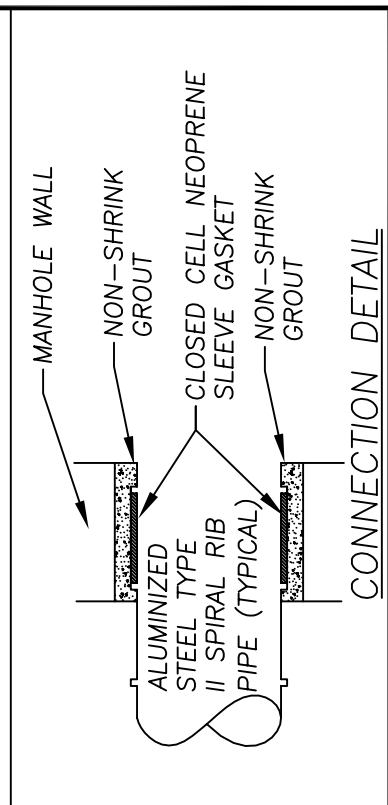
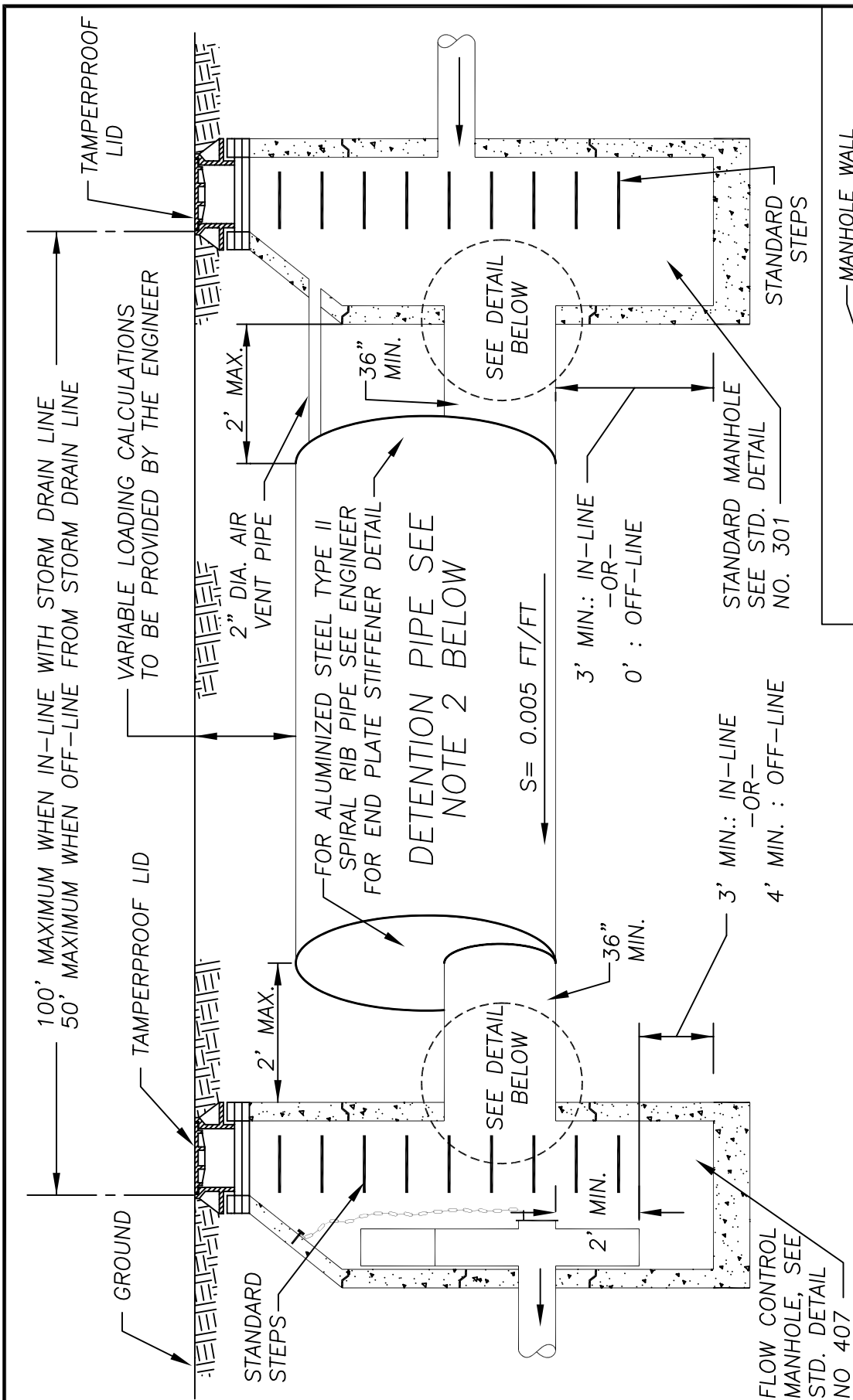
DRAWN	TNP
DIV.	STORMWATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
NON-GRATED INLET-MANHOLE-A

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OR</i>
DWG. NO.	405D



DRAWN	TNP	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 FLOW CONTROL MANHOLE	SCALE	N.T.S.
DIV.	STORMWATER		DATE	JAN. 1,2006
REV.	DATE		APPR.	<i>OR</i>
			DWG. NO.	407



NOTES:

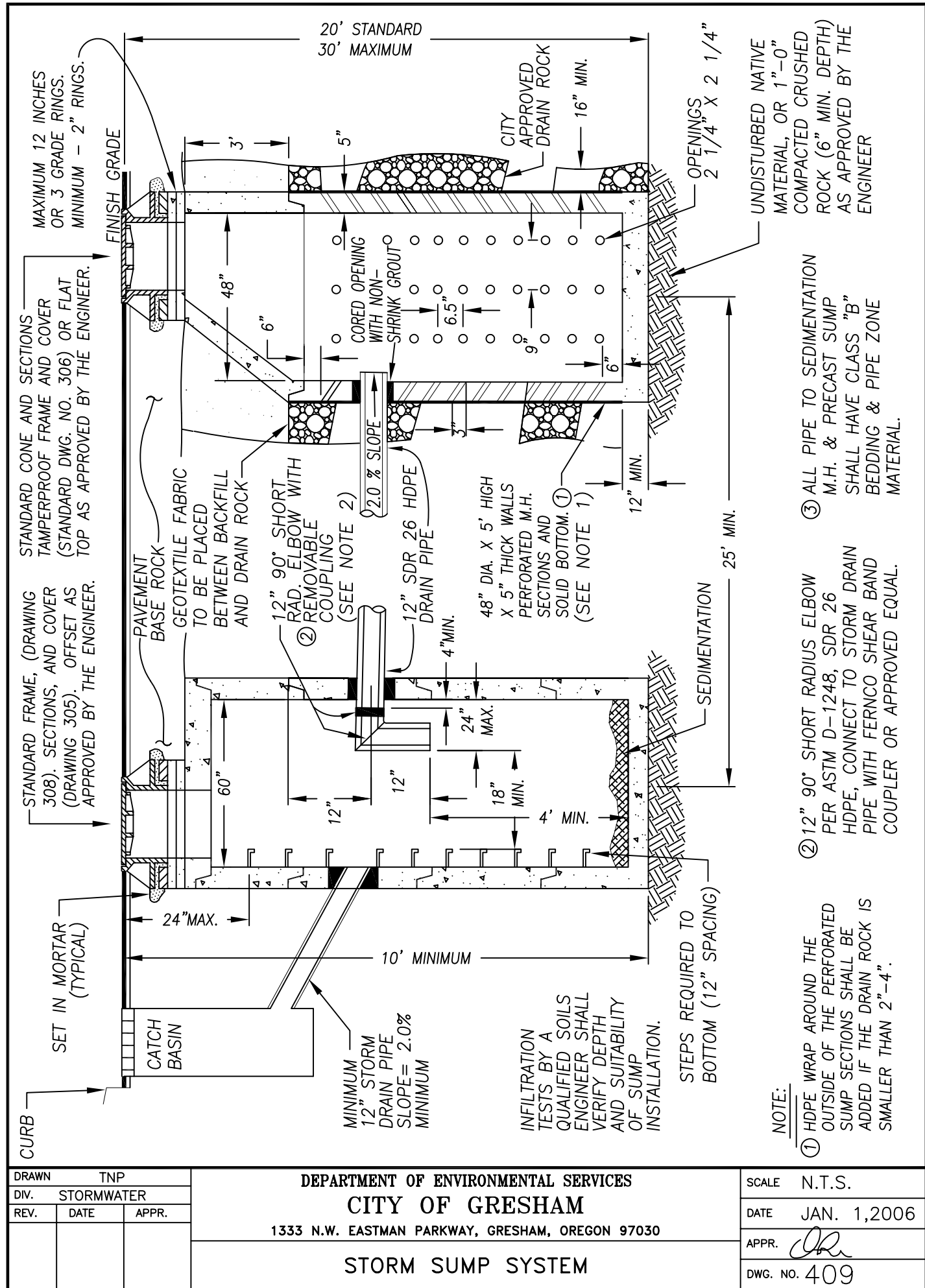
1. THIS DETAIL REPRESENTS A DESIGN CONCEPT. FINAL DESIGN MAY VARY DEPENDING ON SITE CONDITIONS AND SHALL BE APPROVED BY THE CITY ENGINEER.
2. DETENTION PIPE TO BE MADE WATERTIGHT.

DRAWN	TNP	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

DETENTION PIPE
 TYPICAL CLOSED

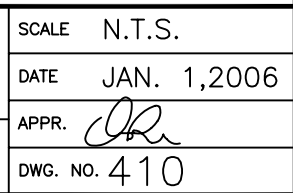
SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>OR</i>
DWG. NO.	408

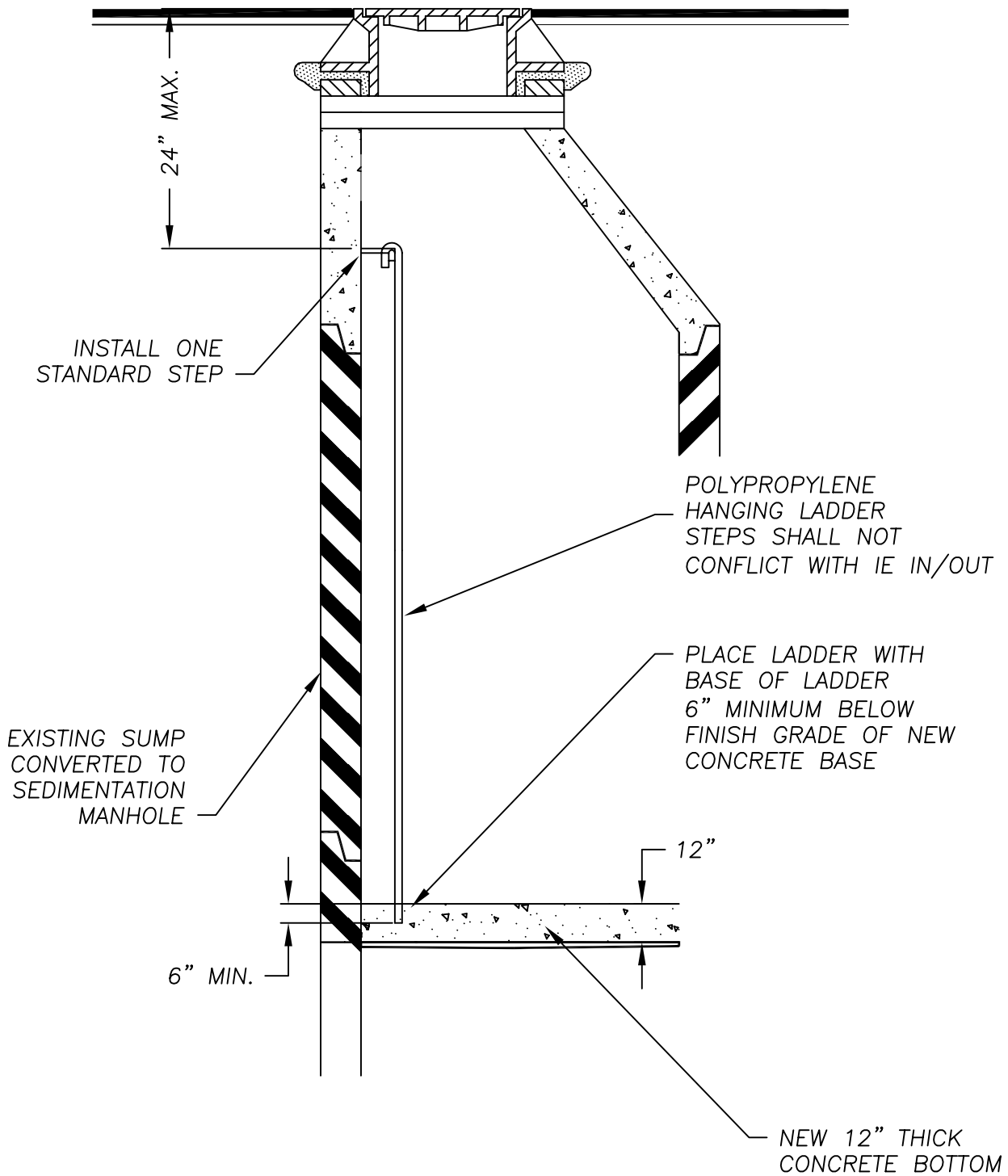



DRAWN	TNP
DIV.	STORMWATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STORM SUMP SYSTEM

SCALE	N.T.S.
DATE	JAN. 1,2006
APPR.	<i>[Signature]</i>
DWG. NO.	409

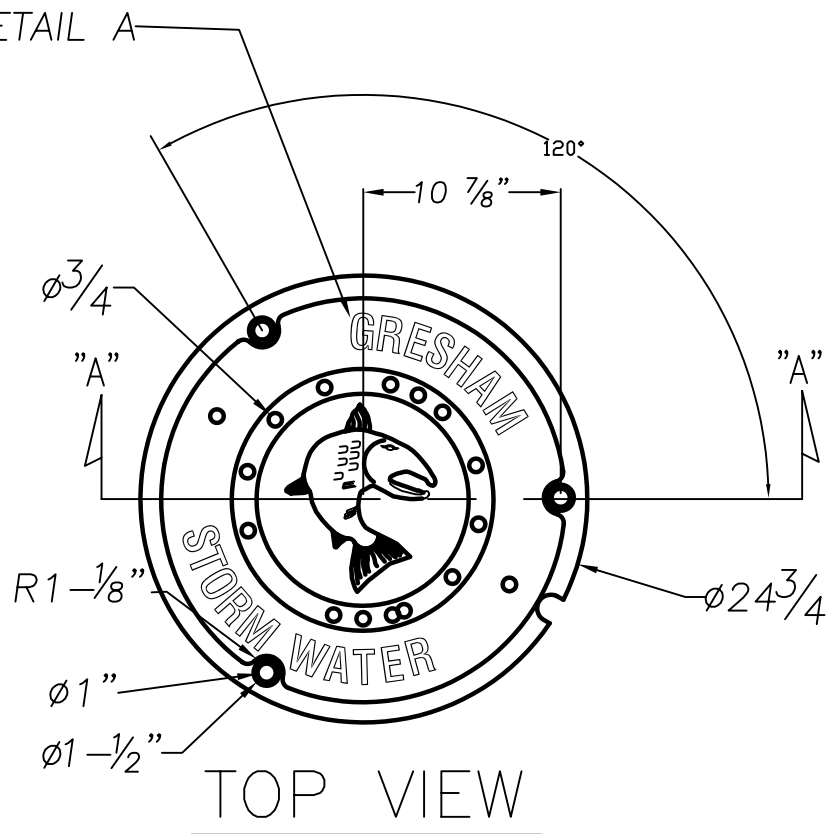




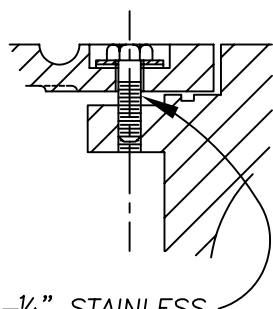
DRAWN TNP			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 POLYPROPYLENE HANGING LADDER	SCALE N.T.S.
DIV. STORMWATER				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 411



DETAIL A
RAISED TEXT

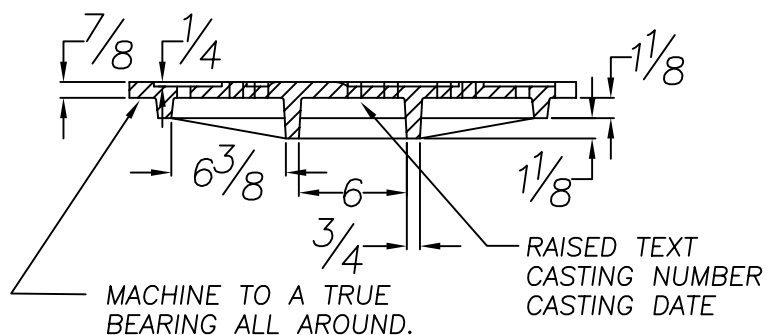


TOP VIEW



1/2"-13 NC X 1-1/4" STAINLESS
STEEL HEX HEAD CAP SCREW
W/1-1/4" Ø OD X 3/32" THK. 8-18
STAINLESS STEEL WASHER & 3/32"
NEOPRENE WASHER, (3) EA. REQUIRED.

LOCKDOWN DETAIL



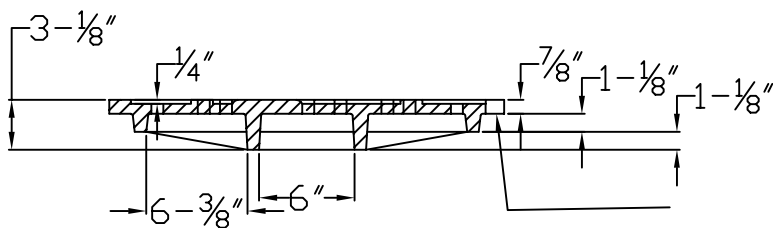
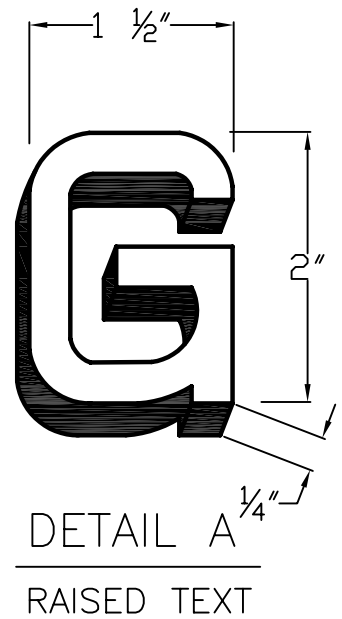
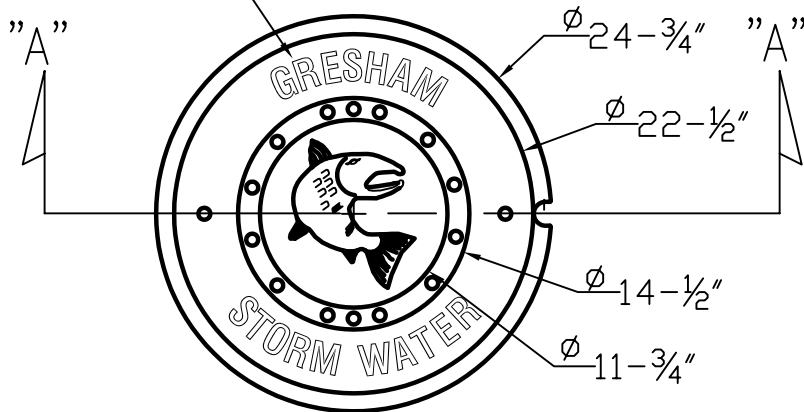
SECTION A-A

DRAWN	BOEB-RRB	
DIV.	STORMWATER	
REV.	DATE	APPR.

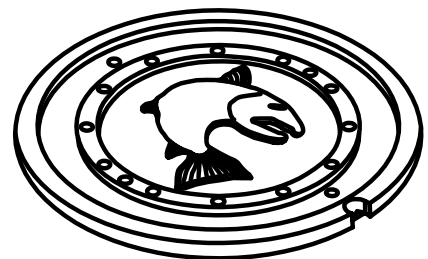
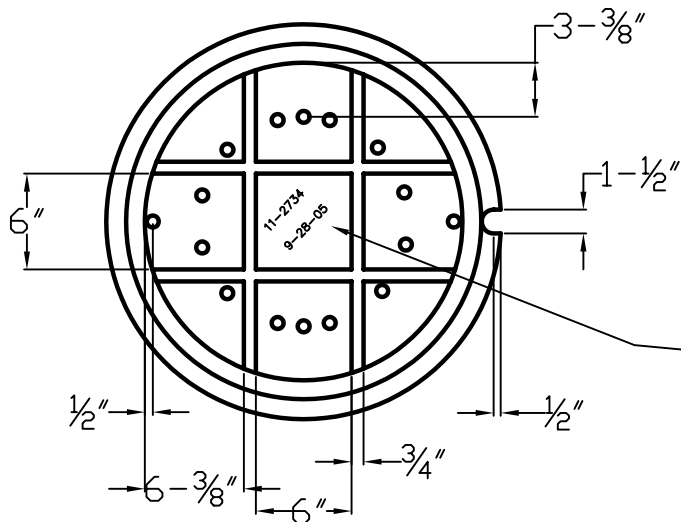
DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STORMWATER TAMPERPROOF
MANHOLE COVER

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OK</i>
DWG. NO.	413A

DETAIL "A"



SECTION A-A



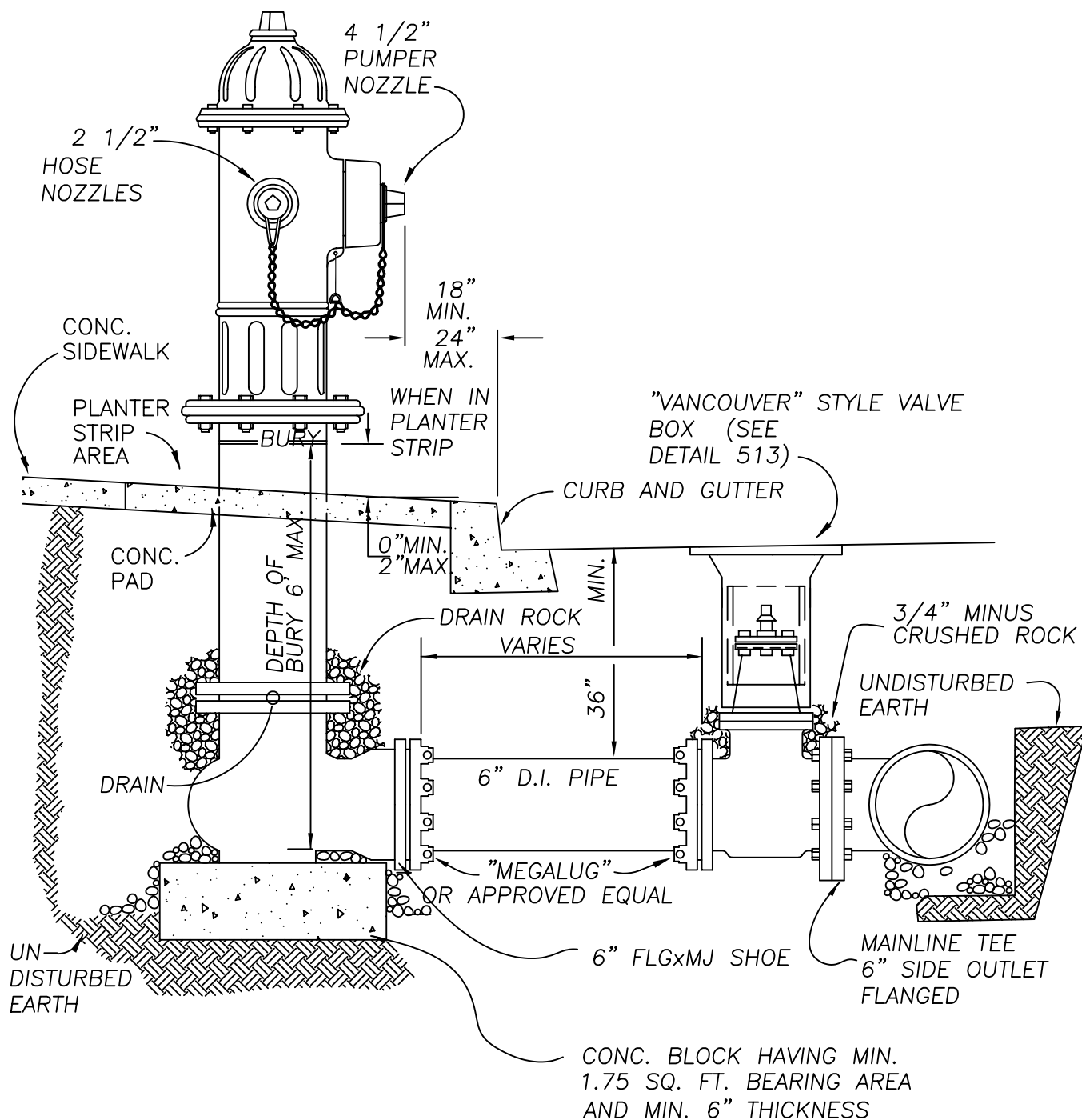
RAISED TEXT NOT SHOWN

RAISED TEXT
Casting Number
Casting Date

DRAWN	BOEB-RRB	
DIV.	STORMWATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STORMWATER
MANHOLE COVER

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OK</i>
DWG. NO.	413B



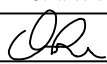
DRAWN	RWL	
DIV.	WATER DIVISION	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
STANDARD FIRE HYDRANT ASSEMBLY		

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	501A

NOTES:

1. HYDRANT TO BE MUELLER SUPER CENTURION 250, MDL A-423 ONLY WITH 1-½" OPERATION NUT. SEE 502.12, DIVISION 5, "WATER TECHNICAL REQUIREMENTS".
2. HYDRANT COLOR TO BE YELLOW SHERWIN WILLIAMS GCC-5006, OR APPROVED EQUAL.
3. ALL MJ'S ON TEE, VALVE AND FIRE HYDRANT TO BE RESTRAINED WITH "MEGALUG" FOLLOWER GLANDS OR APPROVED EQUAL. RESTRAIN MIN. 10 LF OF PIPE EACH SIDE OF TEE ON MAIN LINE AND ALL PIPE AND FITTINGS RESTRAIN ON THE BRANCH SIDE OF TEE. NO JOINTS BETWEEN VALVE AND SHOE UNLESS PIPE RUN LENGTH IS OVER 18 LF.
4. MIN. 4' CU. FT. OF 1-½"-¾" CLEAN DRAIN ROCK SHALL BE PLACED AROUND SHOE UP TO A MIN. OF 6" ABOVE DRAIN OUTLETS
5. WHERE CURB TIGHT SIDEWALK (NO PLANTER STRIP) AND CURB EXIST, HYDRANT PUMPER PORT SHALL BE PLACED AT BACK OF SIDEWALK, OR AS DIRECTED BY ENGINEER.
6. BURY OF HYDRANT SHALL BE MEASURED FROM BURY LINE TO BOTTOM OF CONNECTING PIPE. HYDRANT SHALL HAVE A MAX. OF A 6' BURY, UNLESS OTHERWISE APPROVED BY THE ENGINEER.
7. HYDRANT VALVE SHALL BE MUELLER RESILIENT WEDGE GATE VALVE #A-2360-16 OR APPROVED EQUAL.
8. WHERE NO SIDEWALK EXISTS AROUND A HYDRANT, INCLUDING A PLANTER STRIP, PLACE A 5'x5'x4" THICK CONC. PAD AROUND HYDRANT. PLACE ANY ADJACENT SIDEWALK AT THE TIME HYDRANT PAD IS POURED. EXPANSION JOINT MATERIAL SHALL BE PLACED AROUND HYDRANT BARRELL WHEN PLACED IN CONCRETE.

DRAWN RWL			<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>STD. F.H. ASSEMBLY SPECIFICATIONS</div>	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
	RWL			DWG. NO. 501B

IF NATIVE MATERIAL IS UNSUITABLE FOR BACKFILL, APPROVED GRANULAR MATERIAL WILL BE REQ'D

NATIVE MATERIAL OR 4" OF 1" MINUS AS REQUIRED.

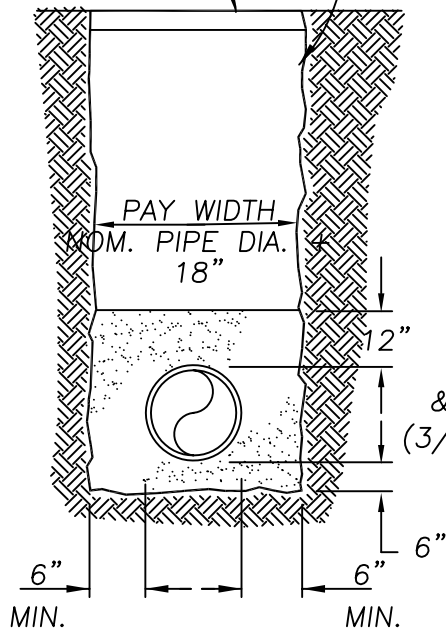
SAW CUT EXISTING A.C. TO NEAT, STRAIGHT LINES.

3" A.C. PAVEMENT OR SAME AS EXIST. DEPTH, WHICHEVER IS GREATER, OR AS REQ'D BY PERMIT.

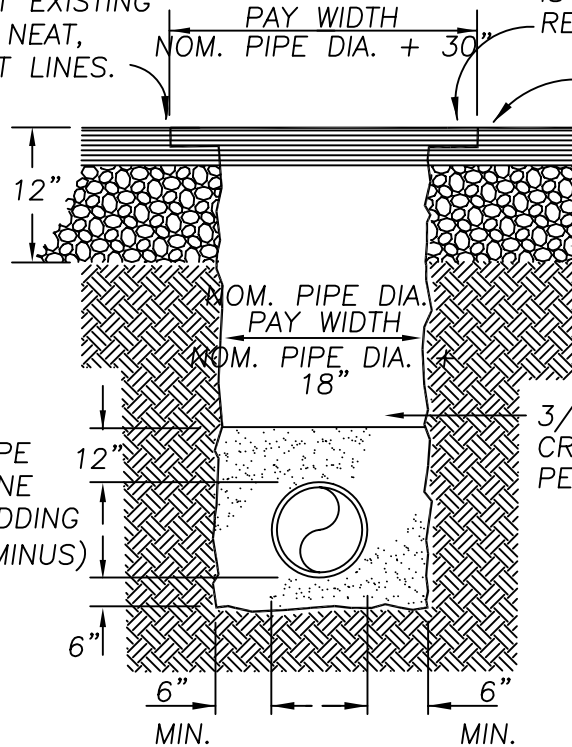
T-CUT 1 1/2" THICK OR DEPTH OF EXIST. TOP LIFT, WHICHEVER IS GREATER

EXIST. BASE ROCK

3/4" MINUS CRUSHED AGG. PER CITY SPECS.




UNPAVED
EASEMENT SECTION

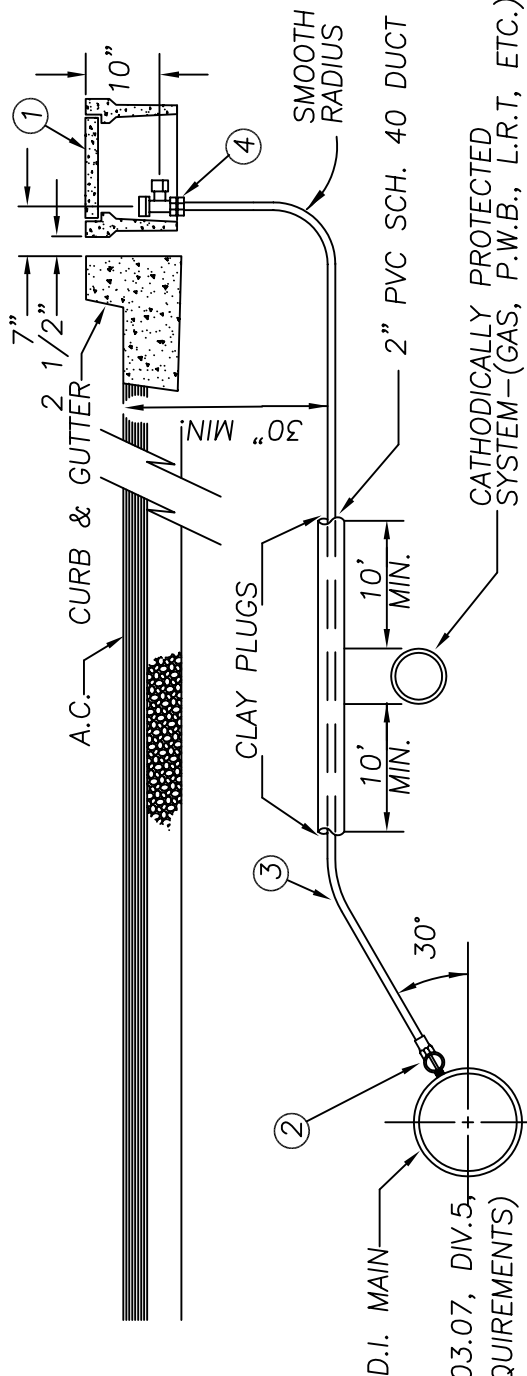


PAVING
SECTION

NOTES.

1. ALL WATER MAINS SHALL HAVE A MIN. COVER OF 36" IN RIGHT-OF-WAY AND 48" IN EASEMENTS
2. ALL TRENCH BACKFILL SHALL BE COMPACTED TO 95% OF MAX. DENSITY PER AASHTO T-180.
3. ALL TRENCH BACKFILL AND PATCHING SHALL CONFORM TO THE STANDARDS AND SPECIFICATIONS OF THE CITY.
4. PAYMENT FOR PAVEMENT CUT AND REPAIR SHALL INCLUDE ALL A.C. AND CRUSHED AGGREGATE TO 12" BELOW FINISH GRADE.
5. SAND BACKFILL WILL BE REQ'D IN PIPE ZONE WHEN PIPE LINE IS TO BE POLYBAGGED.
6. BACKFILL SHALL BE PLACED AND COMPACTED IN LIFTS, OR AS DETERMINED IN FIELD BY THE CITY ENGINEER.

DRAWN		RWL		DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD TRENCH SECTION	SCALE	N.T.S.
DIV.		WATER			DATE	JAN.1, 2006
REV.	DATE	APPR.			APPR.	
					DWG. NO.	502



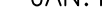
MATERIALS: (SEE 503.07, DIV.5,
WATER TECHNICAL REQUIREMENTS)

CATHODICALLY PROTECTED
SYSTEM - (GAS, P.W.B., L.R.T., ETC.)

1. ARMORCAST METER BOX P6000485, COVER A6000484DQ, DROP-IN A6000484DQ, IN NON-TRAFFIC AREAS. IN TRAFFIC AREAS, A "OLDCASTLE #37 METER BOX SHALL BE USED AND TRAFFIC RATED LID. (OR AN APPROVED EQUAL).
2. MUELLER CORP. STOP #B-25008 (110 COMPRESSION), A.Y. McDONALD #4701BQ, OR AN APPROVED EQUAL.
3. 1" SOFT TEMPER, TYPE "K" COPPER TUBING COMPLYING WITH ASTM B-88.
4. MUELLER, ANGLE METER STOP NO. B-24258, (110 COMPRESSION), A.Y. McDONALD #4602 BQ, OR AN APPROVED EQUAL.

NOTES:

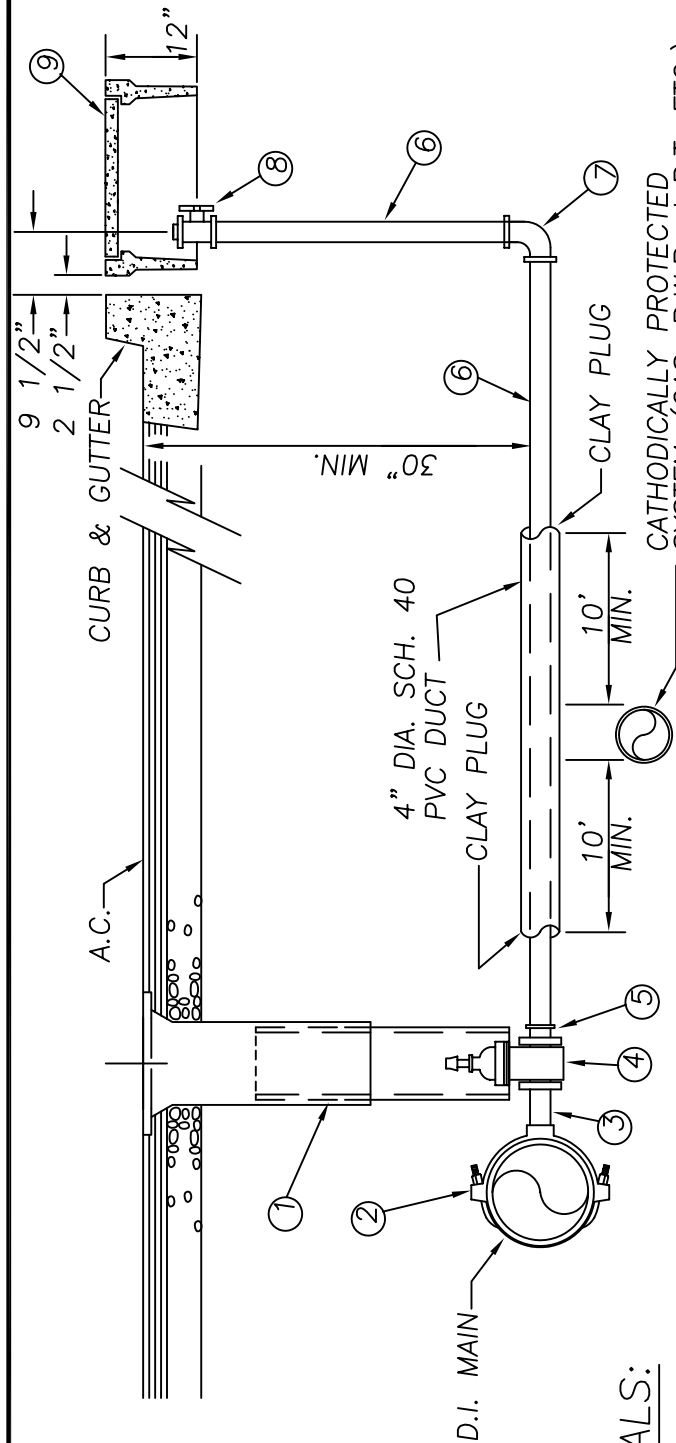
1. SUBSTITUTES FOR ANY MATERIALS SHOWN SHALL BE APPROVED BY THE ENGINEER.
2. ALL PIPE AND STRUCTURE ZONES SHALL BE BACKFILLED USING $\frac{3}{4}$ " MINUS CRUSHED AGG. AND COMPACTED TO 95% MAX. DENSITY AS DETERMINED BY AASHTO T-180.
3. WHEN AN ACTIVE CATHODIC PROTECTED SYSTEM IS ENCOUNTERED, SCH. 40 PVC SHALL BE INSTALLED WITH IMPERVIOUS PLUG AS SHOWN ABOVE.
4. METER BOX SHALL BE CENTERED OVER THE COMPLETED METER ASSEMBLY.
5. FOR VACANT RESIDENTIAL LOTS, LOCATE SERVICE 18" INSIDE SIDE LOT LINE. LOT LINE TO BE PROJECTED PERPENDICULAR TO CURB.
6. ANGLE METER STOP SHALL BE PERPENDICULAR TO CURB LINE.
7. SET CORP. STOP WITH OPERATION NUT AT 3 OR 9 O'CLOCK.
8. TRAFFIC BEARING METER BOX AND LIDS (OLDCASTLE NO. 37 OR APPROVED EQUAL) SHALL BE USED WHERE METERS ARE LOCATED WITHIN ANY PORTION OF DRIVEWAY OR APRON AND OTHER TRAFFIC AREAS.
9. ONLY APPROVED BIT WITH CC THREADS AND TAPPING MACHINE ALLOWED FOR INSTALLATION OF CORP. STOP.
10. COPPER SERVICE SHALL BE INSTALLED IN A DIRECT LINE BETWEEN TAP AND METER.
11. COPPER TO BE ONE CONTINUOUS PIECE (NO UNIONS) UNLESS OTHERWISE APPROVED.

DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD 1" WATER SERVICE			SCALE		N.T.S.	
DIV.			WATER						DATE		JAN.1, 2006	
REV.	DATE	APPR.	APPR.									
									DWG. NO.		503	

DRAWN RWL		
DIV. WATER		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
STANDARD 2" IRRIGATION (1 1/2" - 2" METER)		

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	504A



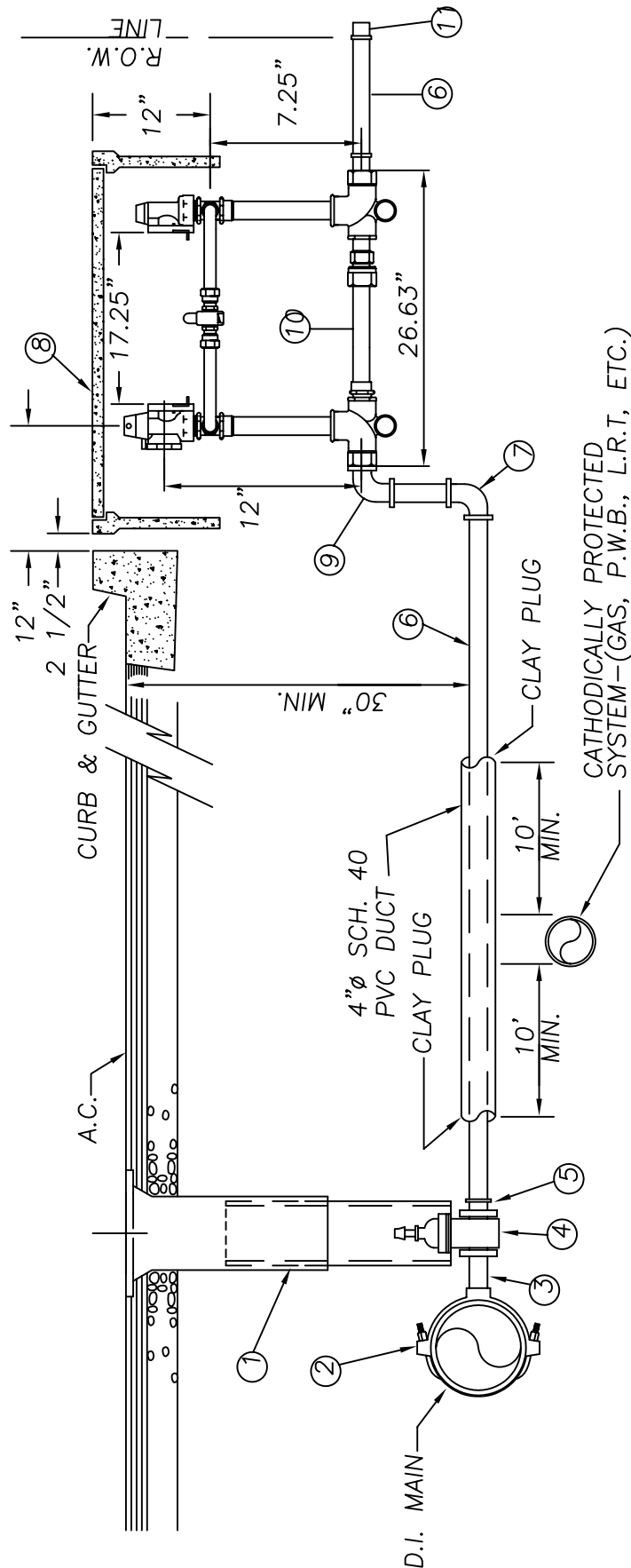
MATERIALS:

(ALSO SEE DIV. 5, 503.07 "WATER TECH. RE'QMENTS") CATHODICALLY PROTECTED SYSTEM—(GAS, P.W.B., L.R.T., ETC.)


1. STANDARD VALVE BOX (SEE DETAIL 513)
2. PIPE O.D. x 2" TEE OR 2" F.I.P. SERVICE SADDLE (A.Y. McDONALD MFG. CO. MODEL 3826 OR APPROVED EQUAL)
3. 2" BRASS M.I.P. NIPPLE, 3" OR 6" LENGTH
4. 2" F.I.P. GATE VALVE (MUELLER NO. A-2369-8 OR APPROVED EQUAL)
5. 2" M.I.P. x MUELLER 110 COMPRESSION COUPLING (NO. H-15428) OR APPROVED EQUAL
6. 2" ASTM B-88 TYPE "K" RIGID COPPER TUBING. SOFT TEMPER REQ'D WITH FLARE FITTINGS.
7. 2" 90° BEND, MUELLER 110 COMPRESSION (NO. H-15526) OR APPROVED EQUAL
8. 2" ANGLE METER STOP, MUELLER NO. H-14277 (110 COMPRESSION) OR APPROVED EQUAL.
9. ARMORCAST METER BOX P6001534x12, COVER A6001643DZ, DROP-IN A600048Z, OR APPROVED EQUAL IN NON-TRAFFIC AREAS.

NOTES:

1. SUBSTITUTES FOR ANY MATERIALS SHOWN SHALL BE APPROVED BY THE ENGINEER.
2. ALL PIPE AND STRUCTURE ZONES SHALL BE BACKFILLED USING 3/4" MINUS CRUSHED AGG. AND COMPACTED TO 95% MAX. DENSITY AS DETERMINED BY AASHTO T-180.
3. WHEN AN ACTIVE CATHODIC PROTECTION SYSTEM IS ENCOUNTERED, SCH. 40 PVC SHALL BE INSTALLED WITH AN IMPERVIOUS CLAY PLUG, AS SHOWN.
4. METER BOX SHALL BE CENTERED OVER THE COMPLETED METER AND FITTING ASSEMBLY.
5. CUSTOMER SHALL INSTALL AN APPROVED BACKFLOW PREVENTION ASSEMBLY AT RIGHT-OF-WAY.
6. ANGLE METER STOP SHALL BE PERPENDICULAR TO CURB LINE.



SEE STANDARD DETAIL DRAWING NO. 504C
FOR MATERIAL AND INSTALLATION NOTES

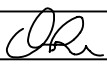
DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD 2" SERVICE – DOMESTIC W/O IRRIGATION (1 1/2" – 2" METER)	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	504B

MATERIALS:

1. STANDARD VALVE BOX, (SEE DETAIL 513)
2. PIPE O.D. x 2" TEE OR 2" F.I.P. SERVICE SADDLE (A.Y. McDONALD MFG. CO. MODEL 3826 OR APPROVED EQUAL)
3. 2" BRASS M.I.P. NIPPLE, 3" OR 6" LENGTH
4. 2" F.I.P. GATE VALVE (MUELLER NO. A-2369-8 OR APPROVED EQUAL)
5. 2" M.I.P. x MUELLER 110 COMPRESSION COUPLING (NO. H-15428) OR APPROVED EQUAL.
6. 2" ASTM B-88 TYPE "K" RIGID COPPER TUBING.
7. 2" 90° BEND, MUELLER 110 COMPRESSION (NO. H-15526) OR APPROVED EQUAL.
8. ARMORCAST METER BOX P6001534X12, COVER A600164312DZ, DROP IN A600048Z.
9. 2" 90° BEND, COMP. x M.I.P. (MUELLER H-15531) OR APPROVED EQUAL.
10. 2" METER YOKE (SETTER) (MUELLER NO. B-2423-99000), OR APPROVED EQUAL.
11. 2" COMP. x F.I.P. (MUELLER H-15451) W/PVC PLUG, OR APPROVED EQUAL.

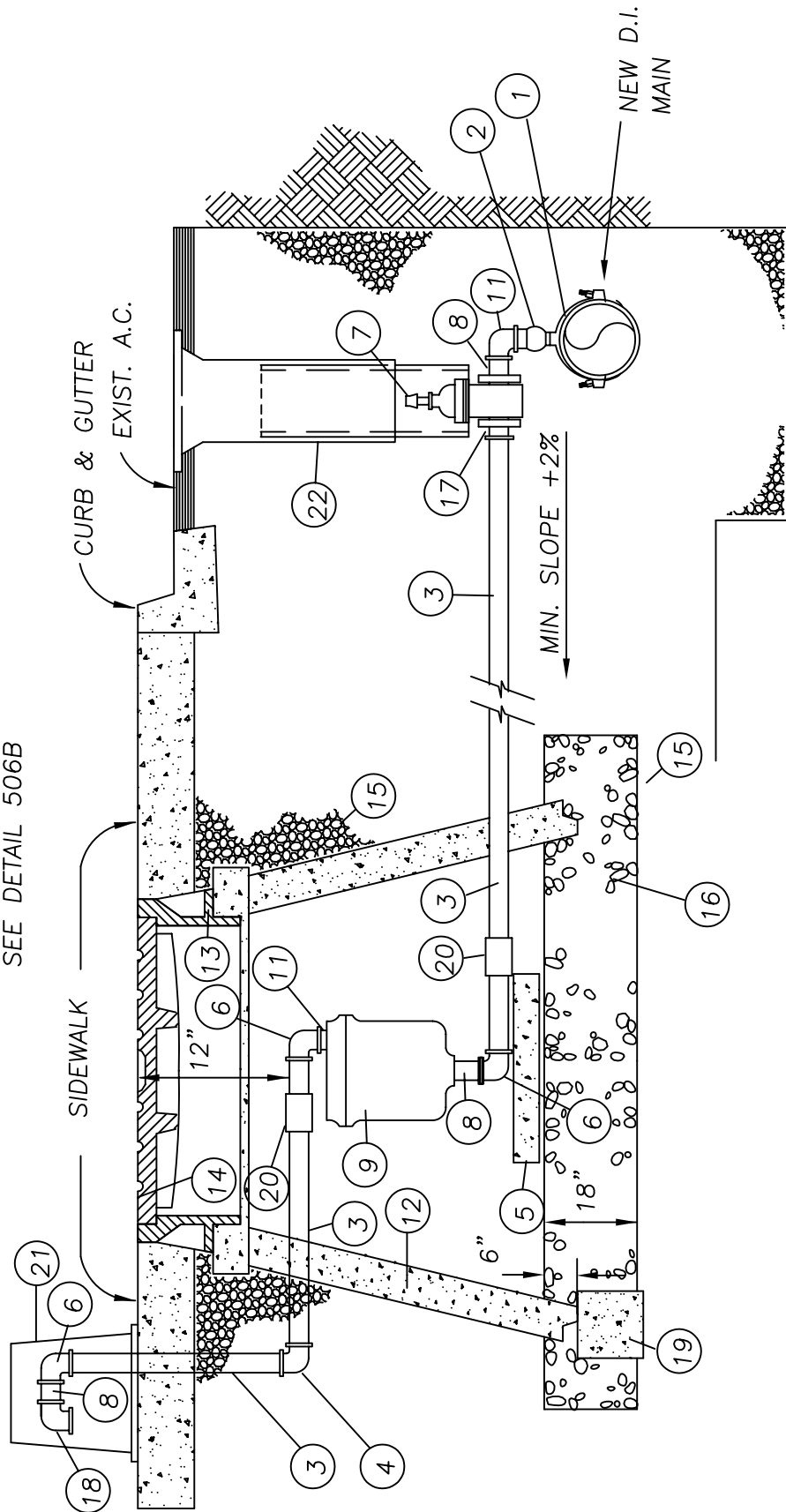
NOTES:

1. SUBSTITUTES FOR ANY MATERIALS SHOWN SHALL BE APPROVED BY THE ENGINEER,
2. ALL PIPE AND STRUCTURE ZONES SHALL BE BACKFILLED USING $\frac{3}{4}$ "-MINUS CRUSHED AGG. AND COMPACTED TO 95% MAX. DENSITY AS DETERMINED BY AASHTO T-180.
3. WHEN AN ACTIVE CATHODIC PROTECTION SYSTEM, IS ENCOUNTERED, SCH. 40 PVC SHALL BE INSTALLED WITH IMPERVIOUS PLUGS, AS SHOWN.
4. METER BOXS SHALL BE CENTERED OVER THE COMPLETED METER AND FITTING ASSEMBLY.
5. CUSTOMER SHALL INSTALL AN APPROVED BACKFLOW PREVENTION ASSEMBLY AT RIGHT-OF-WAY.
6. METER SETTER SHALL BE PERPENDICULAR TO CURB LINE.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE N.T.S.
DIV. T					DATE JAN.1, 2006
REV.	DATE	APPR.	STANDARD 2" SERVICE - DOMESTIC WITH OR W/O IRRIGATION (1 1/2" - 2" METER)		APPR. 
					DWG. NO. 504C

COMBINATION AIR VALVE UNIT SECTION

FOR SPECIFICATIONS OF AIR VALVE UNIT
SEE DETAIL 506B



DRAWN		RWL
DIV.		WATER
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
STANDARD COMBINATION AIR VALVE UNIT		

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	506A

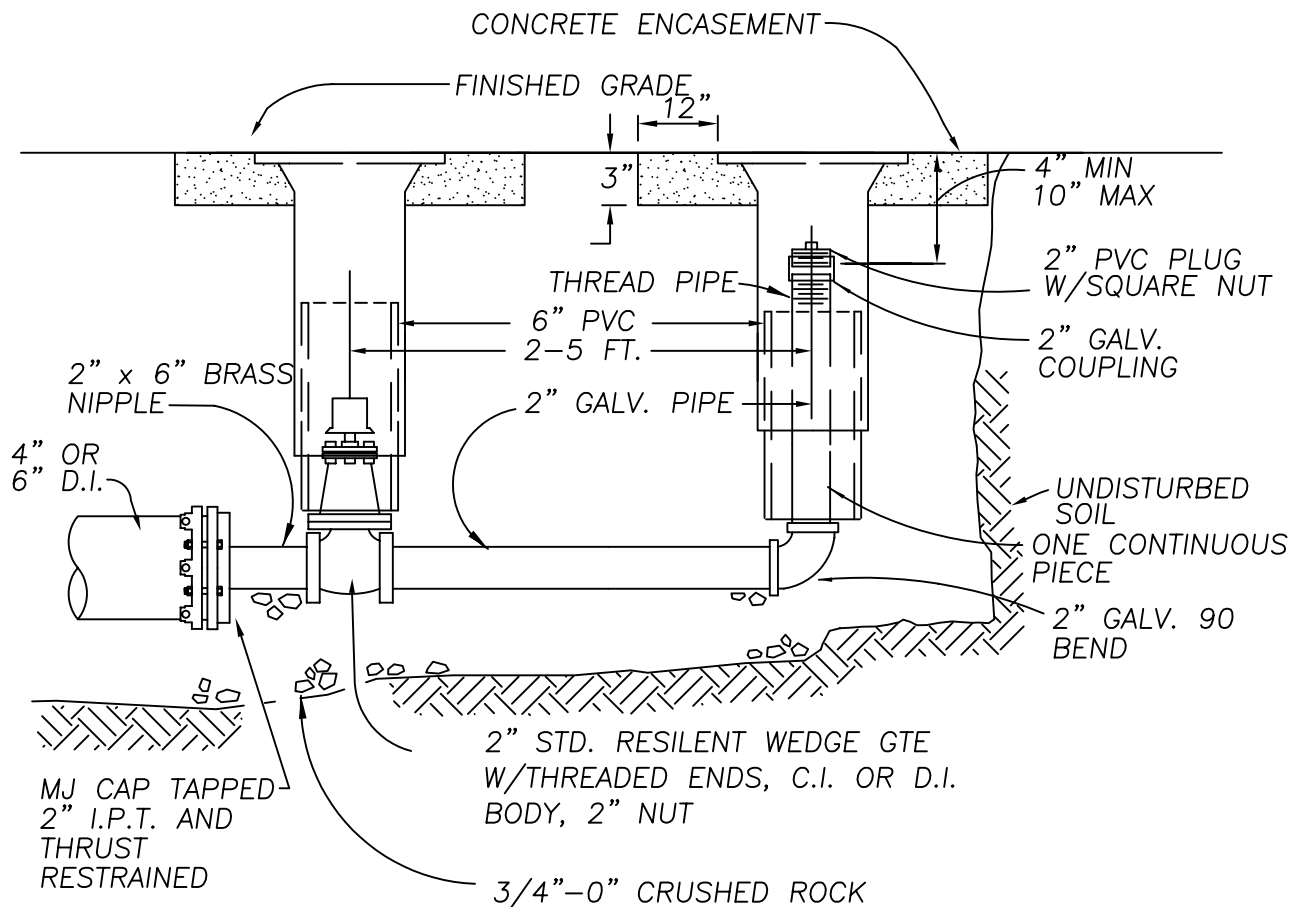
MATERIALS

1. A.Y. McDONALD MDL. 3826 OR APPROVED EQUAL
2. 2" M.I.P. CORP. STORP, MUELLER B-2969, OR APPROVED EQUAL
3. 2" ASTM B-88 RIGID COPPER
4. 2" BRASS ¼ BEND, MUELLER 110 COMPRESSION OR APPROVED EQUAL
5. 12"x12"x4" CONCRETE BLOCK
6. 2" BRASS ¼ BEND, F.I.P. x MUELLER 110 COMPRESSION, OR APPROVED EQUAL.
7. 2" R.W. F.I.P. GATE VALVE
8. 2" x3" BRASS M.I.P. NIPPLE
9. 2" COMBINATION AIR VALVE (VAL-MATIC NO. 202C OR APCO NO. 145C-2 OR APPROVED EQUAL).
10. 2" x 1-½" BRASS M.I.P. NIPPLE
11. 2" F.I.P. BRASS ¼ BEND
12. STD. 48" CONCRETE ECCENTRIC MANHOLE CONE W/NO STEPS
13. VALLEY IRON & STEEL FRAME NO. 106, 108 OR APPROVED EQUAL
14. VALLEY IRON & STEEL LID NO. 105, 107 OR APPROVED EQUAL
15. ¾"-MINUS CRUSHED AGGREGATE.
16. 1-½" - ¾" CLEAN DRAIN ROCK
17. 2" BRASS COUPLING, M.I.P. x MUELLER 110 COMPRESSION OR APPROVED EQUAL
18. 2" F.I.P. BRASS ¼ BEND WITH SCREEN ON OUTLET.
19. 12" MANHOLE ADJUSTMENT RING.
20. 2" UNION, MUELLER 110 COMPRESSION OR A.Y. McDONALD
21. "HOT BOX" (EZBOX NO. EZ75 OR APPROVED EAUAL)
22. STANDARD VALVE BOX. SEE DETAIL 513.

NOTES


1. INSTALLATION LOCATED AT HIGH POINT OF MAIN.
2. 48" MANHOLE BARREL SECTIONS SHALL BE USED TO INCREASE DEPTH IF NECESSARY.
3. ALL PIPE AND STRUCTURE ZONES SHALL BE COMPACTED TO 95% OF MAX. DENSITY AS DETERMINED BY AASHTO T-180 OR AS SPECIFIED IN THE CONTRACT DOCUMENTS.
4. DETAIL NOT FOR SHALLOW INSTALLATIONS. INSTALLATIONS FOR WATERLINES WITH LESS THAN 36" OF COVER SHALL BE INDIVIDUALLY DESIGNED BY THE ENGINEER.
5. GROUT ALL AREAS WHERE COPPER PASSES THROUGH MANHOLE CONE.
6. PLACE "HOT BOX" OR APPROVED EQUAL AT BACK OF SIDEWALK IN UTILITY EASEMENT OR OBTAIN 5' x 5' WATER FACILITY EASEMENT.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD COMBINATION AIR VALVE NOTES	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. <i>OR</i>
				DWG. NO. 506B



NOTES:

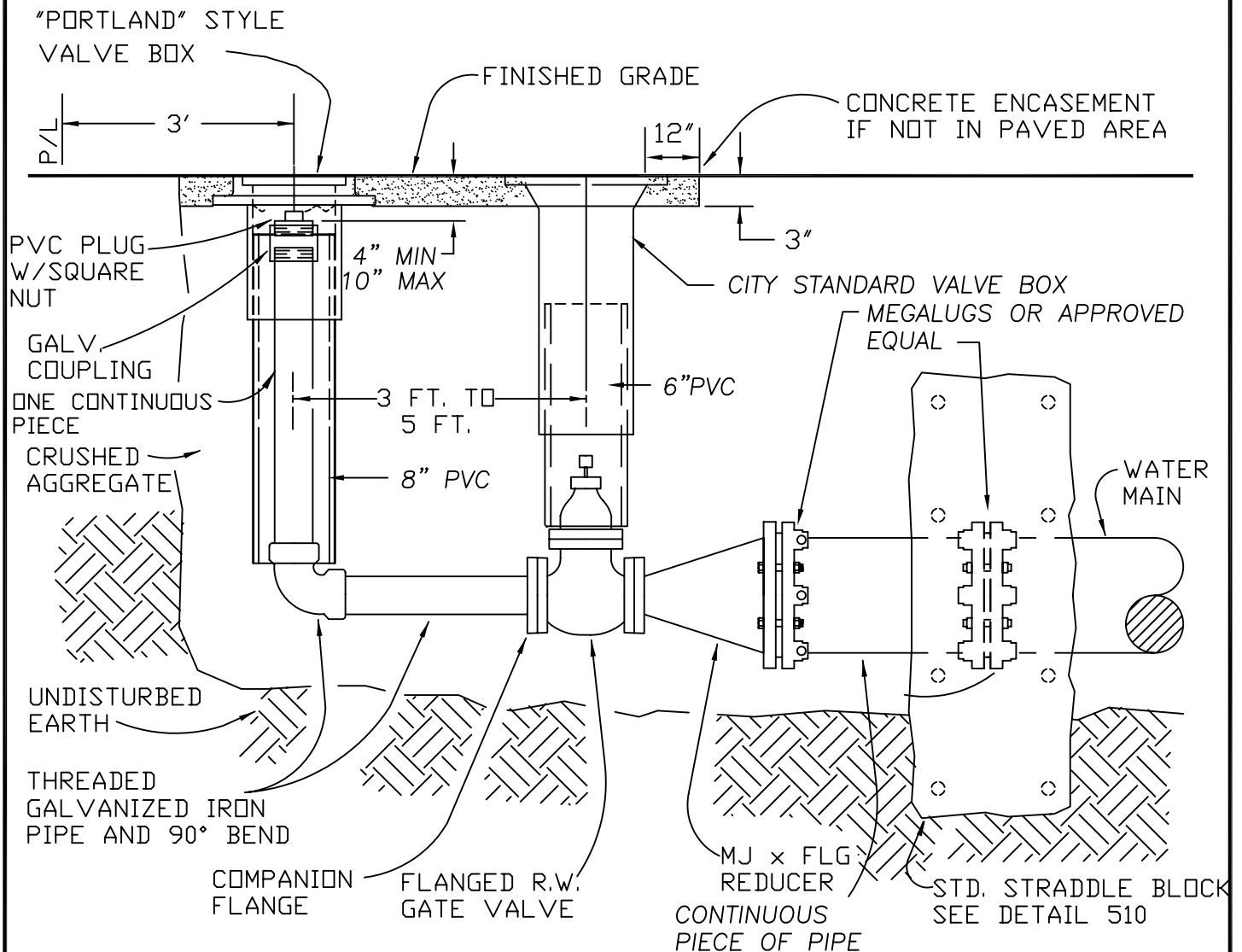
1. USE CITY STANDARD VALVE BOXES, LIDS, AND 6" PVC EXTENSION (SEE DETAIL 513)
2. VALVE BOXES TO BE CONCRETE ENCASED AS SHOWN, IF NOT IN PAVED AREA.
3. BLOW-OFF UNIT SHALL BE BACKFILLED WITH $\frac{3}{4}$ "-0" CRUSHED ROCK AND COMPACTED TO 95% OF MAX. DENSITY AS DETERMINED BY AASHTO T-180.
4. PLACE BLOW-OFF STANDPIPE 3 FT INSIDE R.O.W. LINE AT THE END OF STREET (2 FT. FROM BARRICADE).
5. 2" GALVANIZED TO BE ONE CONTINUOUS PIECE.
6. USE EBAA IRON "MEGALUG" OR APPROVED EQUAL RETAINER GLAND ON MJ CAP. RESTRAIN A MIN. 70 LF OF PIPE PRIOR TO BLOW-OFF OR INSTALL A STRADDLE BLOCK.
7. 2" PVC PLUG W/SQUARE NUT TO BE HAND TIGHTENED ONLY.

DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD 2" BLOW-OFF ASSEMBLY FOR 4" AND 6" WATERLINES	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	507A

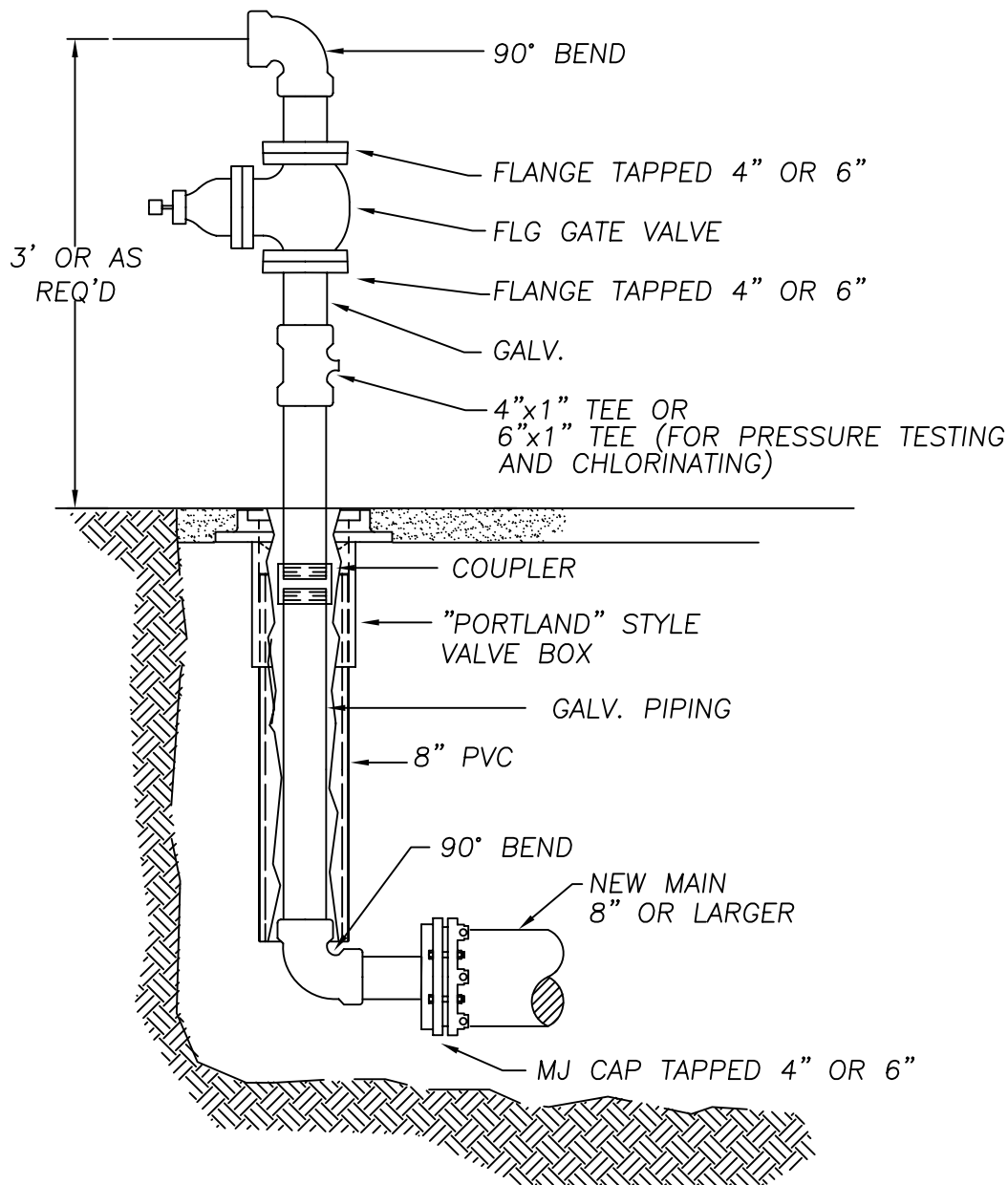
NOTES:

1. BACKFILL WITH SELECT CRUSHED AGGREGATE A MINIMUM OF 6" ON ALL SIDES.
2. ON TEMPORARY BLOW-OFFS ONLY, AN MJ CAP TAPPED 4" OR 6" MAY BE SUBSTITUTED FOR REDUCER.
3. TEMPORARY BLOW-OFF IS ONE REMOVED AT THE END OF PROJECT CONSTRUCTION. A PERMANENT BLOW-OFF REMAINS ON THE PROJECT AFTER ACCEPTANCE.
4. PLACE BLOW-OFF STANDPIPE 3 FT. INSIDE P/L. LINE AT END OF STREET (2 FT. FROM BARRICADE).
5. USE CITY STANDARD VALVE BOX, LID, AND 6" PVC EXTENSION FOR BLOW-OFF VALVE. USE "PORTLAND" STYLE VALVE BOX, LID, AND 8" PVC EXTENSION FOR BLOW-OFF STAND PIPE (SEE DETAILS 513 & 514)

BLOW-OFF SIZES REQUIRED	
MAIN SIZE	BLOW-OFF SIZE
4" TO 6"	2"
8" TO 12"	4"
14" TO 18"	6"
20" & UP	PER ENGR.




DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 PERMANENT OR TEMPORARY 4" & 6" BLOW-OFF	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. <i>[Signature]</i>
				DWG. NO. 507B



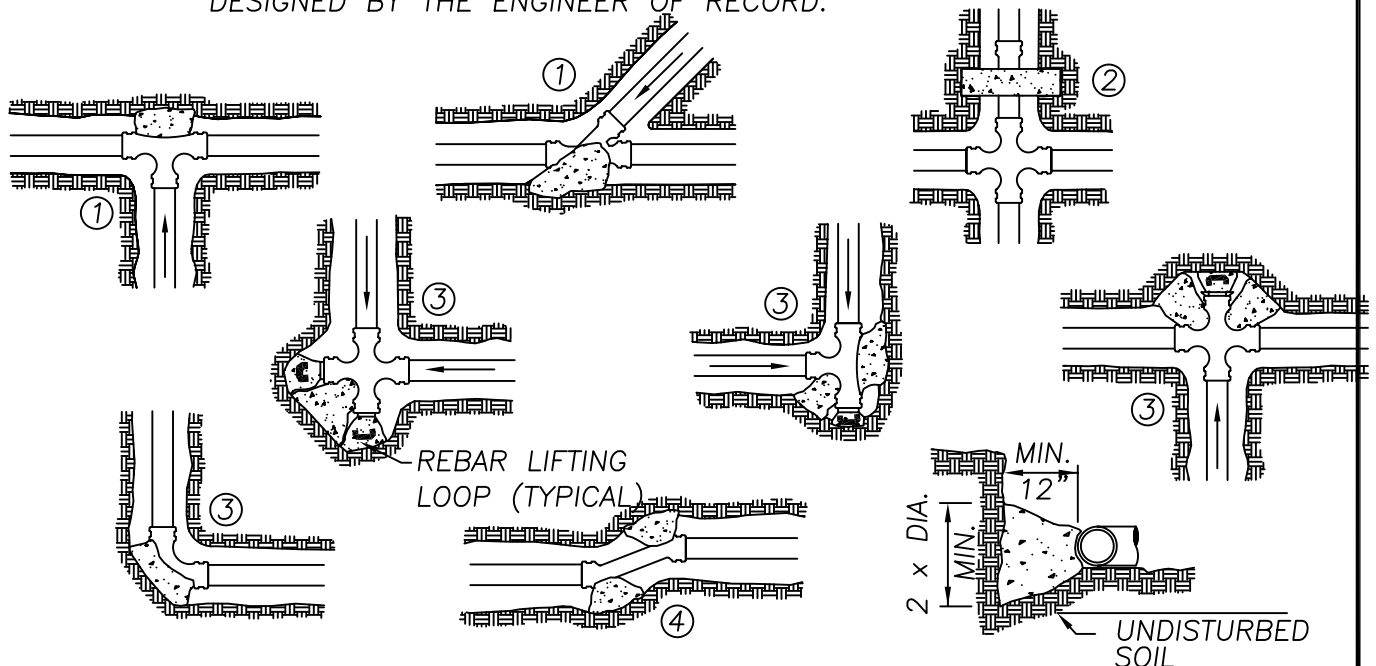
NOTES:

1. ALL FILLING, FLUSHING, AND TESTING OF NEW WATERLINE FACILITIES SHALL BE DONE THROUGH A 6" DOUBLE CHECK ASSEMBLY WITH A METERING DEVICE.
2. PROVIDE TEMPORARY BLOCKING AS REQUIRED.
3. ALL PIPING AND FITTINGS SHALL BE GALVANIZED IRON.
4. FOR 8"-12" WATERLINES: FILL POINT SHALL BE 4" PIPING AND FITTINGS. FOR 14"-18" WATERLINES: FILL POINT SHALL BE 6" PIPING AND FITTINGS. FOR 20" AND LARGER: FILL POINT SHALL SIZED AS DETERMINED BY THE ENGINEER.

DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD 4" AND 6" TEMPORARY FILL POINT	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	507C

FITTING SIZE (Inches)	TEE, & WYE ①	STRADDLE BLOCK ②	90° BEND PLUGGED CROSS TEE PLUGGED—RUNS ③	45° BEND ④	22 1/2° BEND ④	11 1/4° BEND ④
2	*	*	*	*	*	*
4	1.7	2.1	2.4	1.3	*	*
6	3.7	4.9	5.3	2.9	1.5	*
8	6.7	8.7	9.5	5.1	2.7	1.3
10	10.5	13.6	14.8	8	4.1	2
12	15.1	19.6	21.3	11.6	5.9	2.9
16	26.8	34.8	37.9	20.5	10.4	5.2
18	33.9	44	47.9	25.9	12.8	6.7
LARGER	* *	* *	* *	* *	* *	* *
BEARING AREA OF THRUST BLOCKS (sq. ft.)						

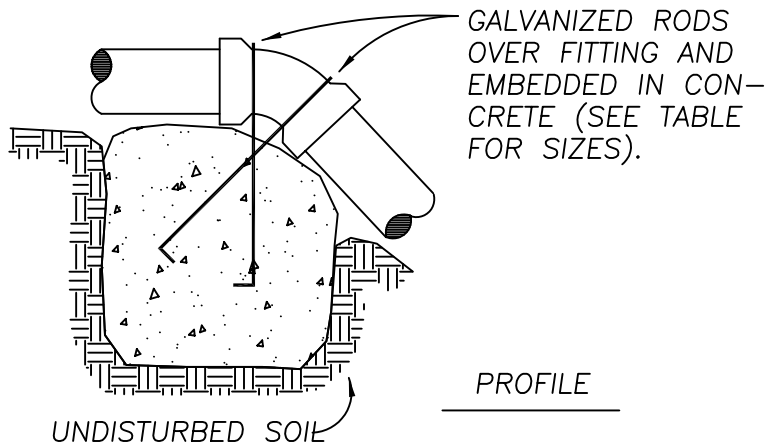
- ALL VALUES ARE BASED ON THE FOLLOWING ASSUMPTIONS:
AVG. PRESSURE = 100 PSI x 2 (safety factor); 1500 PSF SOIL BEARING CAPACITY; NORMAL DISTRIBUTION DESIGN VELOCITY NOT TO EXCEED 8 F/S.
 - ALL FITTINGS SHALL BE WRAPPED IN PLASTIC PRIOR TO PLACEMENT OF CONCRETE.
 - ALL THRUST BLOCKS SHALL BE FORMED TO ELIMINATE ANY CONCRETE AROUND FITTING BOLTS.
 - BEARING SURFACE OF THRUST BLOCKING SHALL BE AGAINST UNDISTURBED SOIL.
 - ALL CONCRETE MIX SHALL HAVE A MIN. 28 DAY STRENGTH OF 3300 PSI.
 - ALL PIPE ZONES SHALL BE GRAVEL FILLED AND COMPACTED.
 - THRUST BLOCKS FOR PLUGGED CROSS AND PLUGGED TEE SHALL HAVE #4 REBAR LIFTING LOOPS INSTALLED AS SHOWN.
 - VERTICAL THRUST DETAILS – SEE DWG. #509
 - STRADDLE BLOCK DETAILS – SEE DWG. #510.
 - EACH PROPOSED MECHANICAL RESTRAINT LENGTHS SHALL BE REVIEWED ON A CASE BY CASE BASIS BY THE ENGINEER OF RECORD.
- * BLOCK TO UNDISTURBED TRENCH WALLS
- * * THRUST BLOCKS FOR PIPES LARGER THAN 18" WILL BE INDIVIDUALLY DESIGNED BY THE ENGINEER OF RECORD.



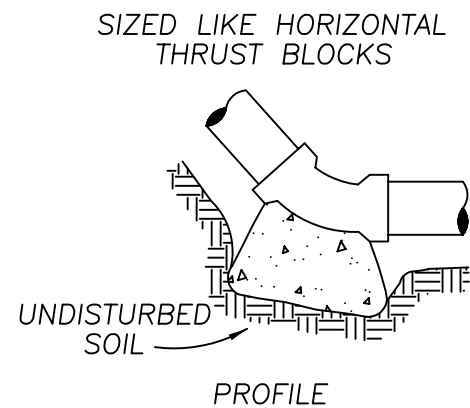
DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 HORIZONTAL THRUST BLOCKING	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. <i>OR</i>
				DWG. NO. 508

NOTES:

1. GRAVITY VERTICAL THRUST BLOCKS AND MECHANICAL RESTRAINT LENGTHS VALUES SHALL BE REVIEWED BY THE ENGINEER OF RECORD.
2. KEEP CONCRETE CLEAR OF JOINT AND JOINT ACCESSORIES. FITTINGS SHALL BE WRAPPED IN PLASTIC PRIOR TO PLACEMENT OF CONCRETE.
3. CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH.
4. CONCRETE MIX SHALL HAVE A MIN. 28 DAY STRENGTH OF 3300 P.S.I.
5. GRAVITY THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 P.S.I.G. AND THE WEIGHT OF CONCRETE = 4050 LBS./CU.YD.
6. VERTICAL BENDS THAT REQUIRE A GRAVITY THRUST BLOCK VOLUME EXCEEDING 5 CUBIC YARDS REQUIRE SPECIAL BLOCKING DETAILS DESIGNED BY THE ENGINEER. NOTE VOLUMNS SHOWN INSIDE HEAVY LINE IN TABLE.
7. PAYMENT SHALL BE THE SAME AS FOR HORIZONTAL THRUST BLOCKS.
8. ALL REBAR SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM-123 (MIN. 3.4 MIL). REBAR SHALL BE BENT BEFORE GALVANIZATION, AND LAST 4" OF BAR SHALL BE BENT 90 DEGREES WITH A 1/2" RADIUS BEND. REBAR SHALL BE TIGHTLY FIT TO RESTRAINED FITTING.
9. FOR HORIZONTAL THRUST BLOCK DETAILS SEE DETAIL NO. 508.



GRAVITY VERTICAL THRUST BLOCK

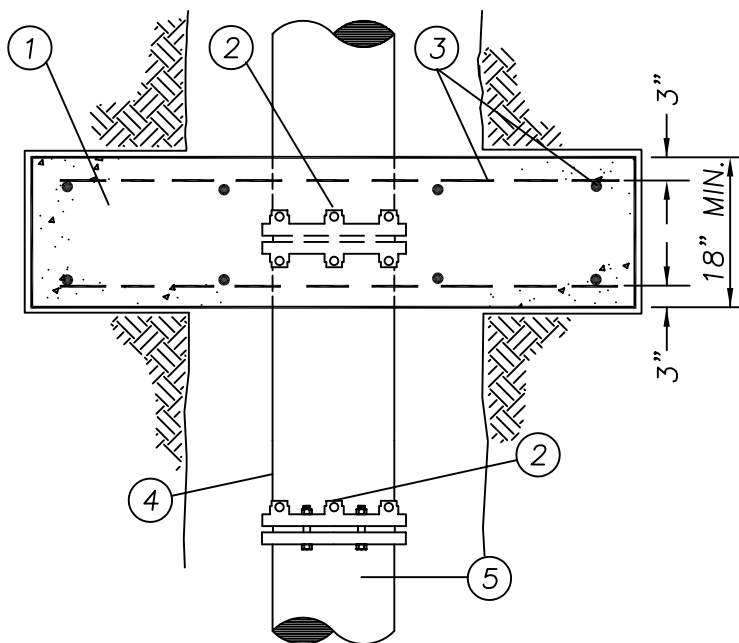


NORMAL VERTICAL
THRUST BLOCK

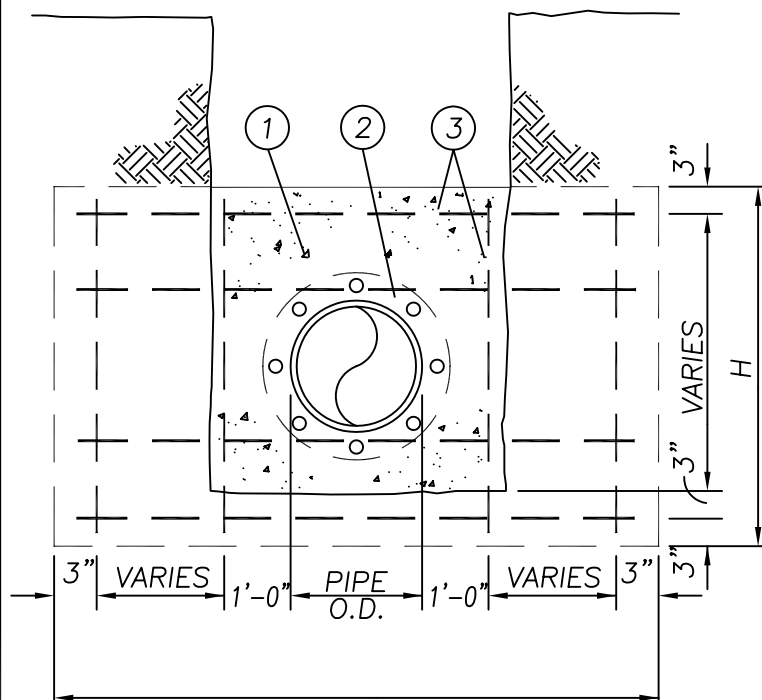
VOLUME OF GRAVITY THRUST BLOCK IN CUBIC YARDS (VERTICAL BENDS)			
FITTING SIZE	BEND ANGLE		
	45 °	22 1/2 °	11 1/4 °
4	1.1	0.4	0.2
6	2.7	1.0	0.4
8	4.0	1.5	0.6
10	6.0	2.3	0.9
12	8.5	3.2	1.3
14	11.5	4.3	1.8
16	14.8	5.6	2.3

FITTING SIZE	ROD SIZE	EMBED- MENT
12" AND LESS	#6	30"
14" - 16"	#8	36"

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 VERTICAL THRUST BLOCKING	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. <i>[Signature]</i>
				DWG. NO. 509



TOP VIEW




FRONT VIEW

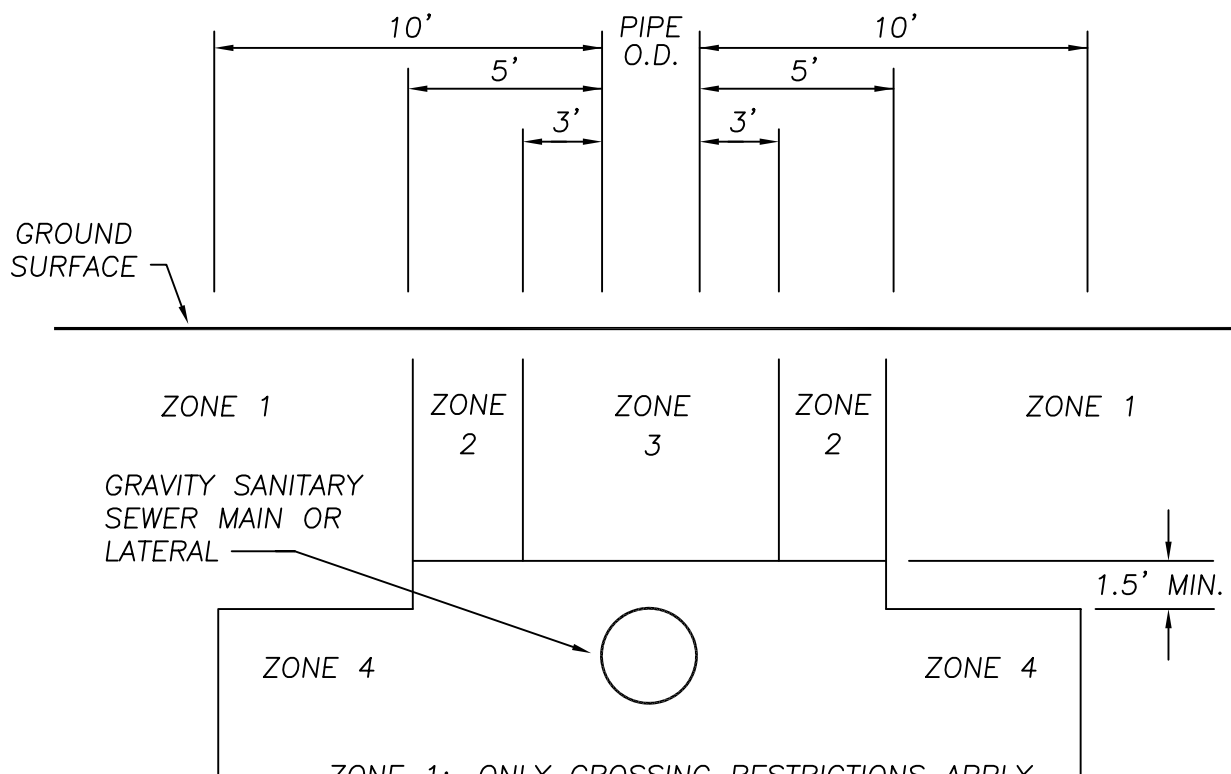
MATERIALS:

1. CONCRETE STRADDLE BLOCK.
2. 2-MEGALUG OR APPROVED EQUAL RETAINER GLANDS
3. #4 REBAR EACH WAY, 12" O/C.
4. NO JOINTS ALLOWED BETWEEN STRADDLE BLOCK AND FITTING/BLOW-OFF ASSEMBLY.
5. FITTING/BLOW-OFF ASSEMBLY

NOTES:

1. STRADDLE BLOCKS HEIGHT AND WIDTH SHALL BE DESIGNED INDIVIDUALLY BY THE ENGINEER AND SHALL BE BASED ON THE FOLLOWING:
 - a.) 200 PSI WATER PRESSURE
 - b.) SOIL BRG. CAPACITY
 - c.) STEEL SIZE AND SPACING
2. BEARING AREA OF BLOCK SHALL BE AGAINST UNDISTURBED SOIL.
3. STRADDLE BLOCK SHALL HAVE A MINIMUM OF 18" COVER.
4. CONCRETE SHALL HAVE A MIN. 28-DAY STRENGTH OF 3300 PSI
5. ALL FITTINGS, & PIPE WITHIN THE CONC. SHALL BE WRAPPED IN 8 MIL. PLASTIC
6. STRADDLE BLOCK HEIGHT (H) & WIDTH (W) SHALL BE DETERMINED BY THE ENGINEER OF RECORD.

DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030			SCALE		N.T.S.	
DIV.			WATER						DATE		JAN.1, 2006	
REV.	DATE	APPR.	STANDARD STRADDLE BLOCK						APPR.			
									DWG. NO.	510		



ZONE 1: ONLY CROSSING RESTRICTIONS APPLY


ZONE 2: CASE-BY CASE DETERMINATION

ZONE 3: PARALLEL WATERLINE PROHIBITED

ZONE 4: PARALLEL WATERLINE PROHIBITED


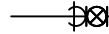
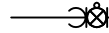

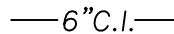






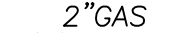



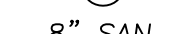
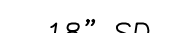


NOTES:

1. WHERE THE PROPOSED WATERLINE WILL BE INSTALLED PARALLEL TO AN EXISTING GRAVITY SANITARY SEWER MAIN OR LATERAL LINE, THE SEPERATION BETWEEN THE TWO SHALL BE AS INDICATED ABOVE.
2. CROSSING:
 - a. WHENEVER POSSIBLE, THE BOTTOM OF THE WATERLINE SHALL BE 1.5 FEET ABOVE THE TOP OF THE SEWER LINE. ONE FULL LENGTH OF WATERLINE SHALL BE CENTERED AT THE CROSSING, REGARDLESS OF VERTICAL SEPERATION.
 - b. WHERE IT IS NOT POSSIBLE FOR THE WATER LINE TO BE 1.5 FEET ABOVE THE SEWER LINE, OR THE WATERLINE PASSES UNDER THE SEWER LINE, THE EXISTING SEWER LINE SHALL BE EXPOSED FOR A DISTANCE OF 10 FEET ON EACH SIDE OF THE CROSSING, AND SHALL BE REPLACED WITH C-900 PVC, DR-18, DR-25 OR CLASS 50 DUCTILE IRON PIPE AS APPROVED BY THE ENGINEER, AND A LENGTH OF WATER PIPE SHALL BE CENTERED AT THE CROSSING, OR AS APPROVED BY THE ENGINEER.
3. SEPERATION FROM FORCE MAIN SANITARY SEWER SHALL BE REVIEWED ON A CASE-BY-CASE BASIS


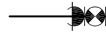
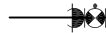

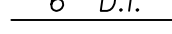

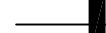


DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD GRAVITY SANITARY SEWER SEPERATION	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	511

LEGEND














EXISTING

	FIRE HYDRANT
	GATE VALVE
	BUTTERFLY VALVE W/Oper.
	WATER METER
	6" C.I. WATER MAIN
	THRUST BLOCK
	MJ PLUG ON MJxFLG TEE
	FLG TEE W/BLIND FLG
	CABLE UNDERGROUND TV CABLE
	PGE UNDERGROUND POWER
	GTE UNDERGROUND TELEPHONE
	2" GAS GAS MAIN W/VALVE
	POWER POLE W/GUY
	CULVERT
	MANHOLE
	8" SAN SANITARY SEWER
	18" SD STORM DRAIN
	SURVEY MONUMENT
	DITCH OR STREAM

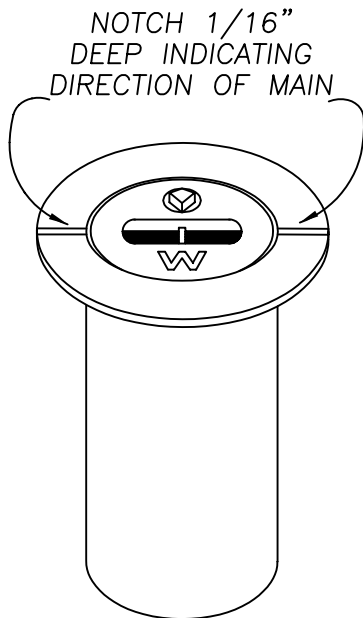
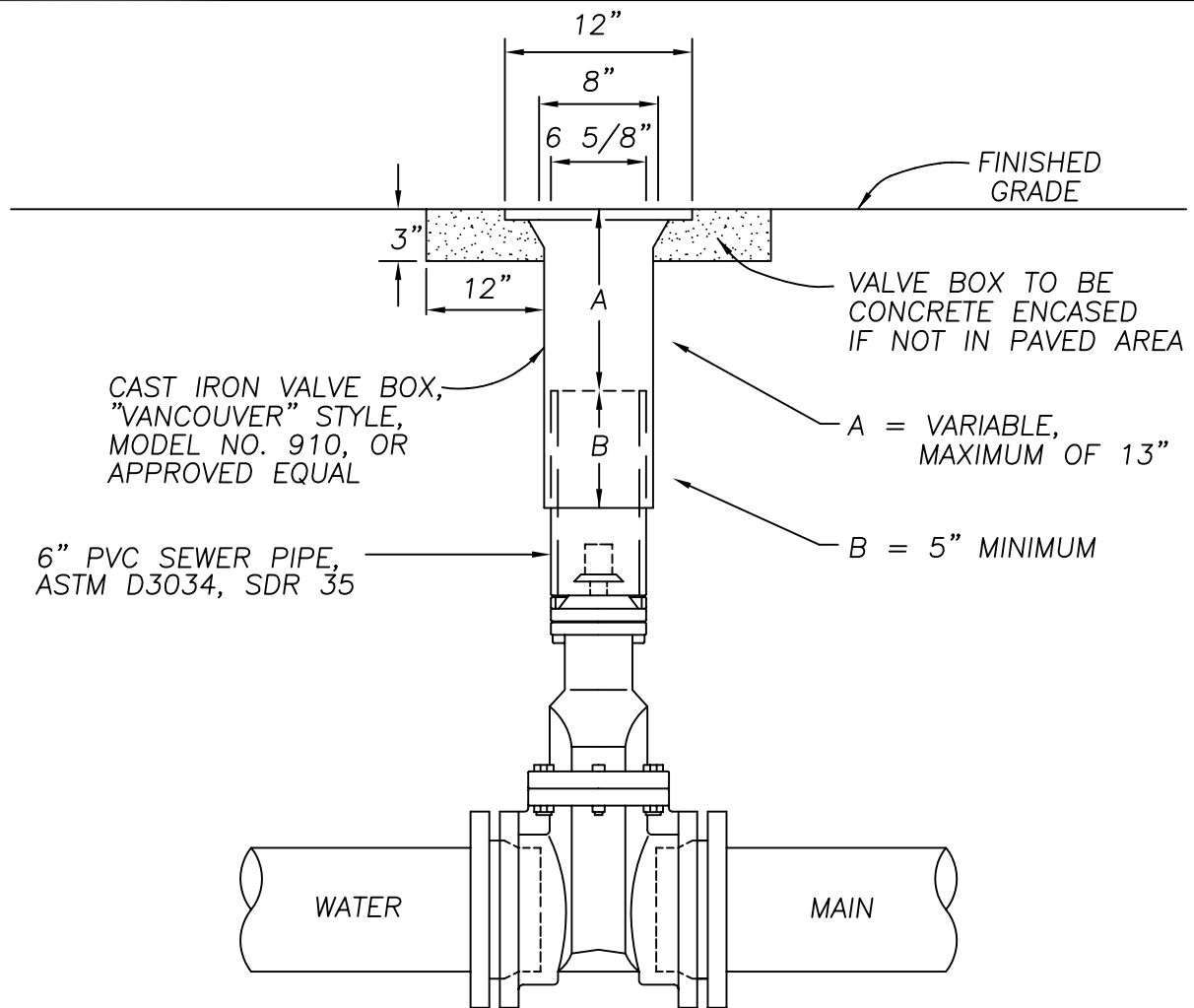
PROPOSED

	FIRE HYDRANT
	MJxFLG GATE VALVE
	MJxFLG B.F.VALVE W/Oper.
	WATER METER
	6" D.I. WATER MAIN
	THRUST BLOCK
	STRADDLE BLOCK
	BLOW-OFF
	SAMPLE STATION

JOINTS and FITTINGS

	FLANGE JOINT (FLG)
	MECHANICAL JOINT
	BELL END OF PIPE
	FLANGED TEE
	45 DEGREE BEND, MJ
	ADAPTER, FLG x MJ
	REDUCER, FLG
	MJ PLUG ON MJxFLG TEE
	MJ CAP
	BLIND FLANGE ON FLG TEE
	SLEEVE OR COUPLING
	MECHANICAL JOINT W/RETAINER GLAND
	RESTRAINED BELL JOINT


DRAWN <u>RWL</u>			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 WATER PROJECT SYMBOLS	SCALE <u>N.T.S.</u>
DIV. <u>WATER</u>				DATE <u>JAN.1, 2006</u>
REV.	DATE	APPR.		APPR. <u>OR</u>
				DWG. NO. <u>512</u>

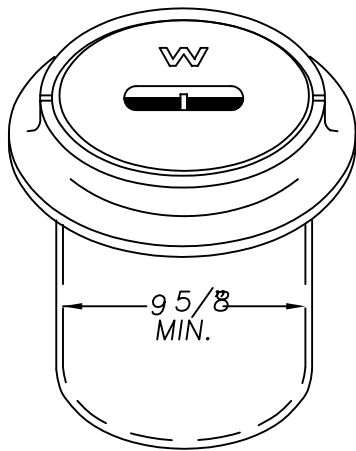
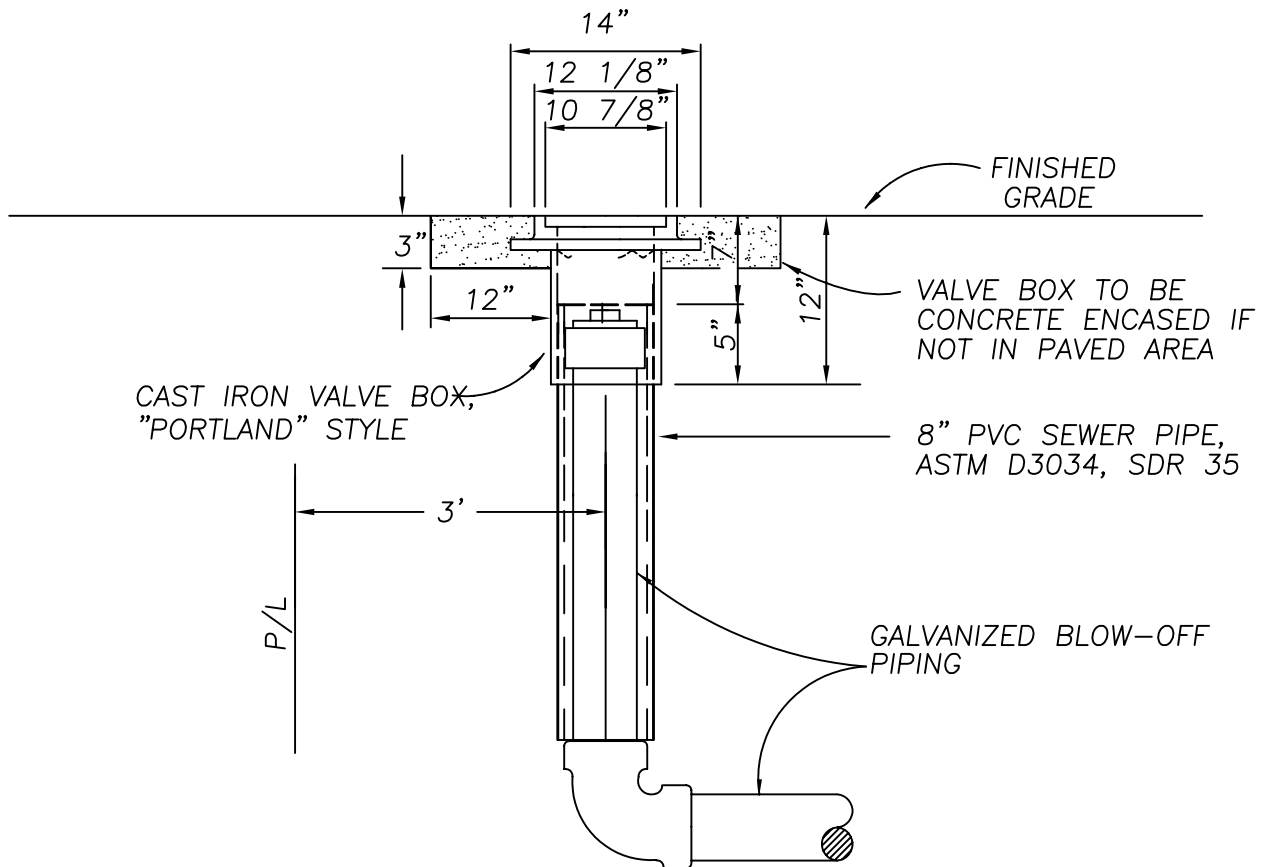


"VANCOUVER" STYLE
18" TALL VALVE BOX

NOTES:

1. VALVE BOXES SHALL BE CENTERED DIRECTLY OVER THE VALVE NUT IN A VERTICAL POSITION.
2. VALVE BOX TOP SHALL BE ADJUSTED TO MEET FINISHED GRADE.
3. PVC SHALL BE ON CONTINUOUS PIECE — NO BELLS OR COUPLERS.
4. USE FOR ALL VALVES AND 2" BLOW-OFF STANDPIPES


DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD VALVE BOX	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	513



"PORTLAND" STYLE
VALVE BOX

NOTES:

1. VALVE BOXES SHALL BE CENTERED DIRECTLY OVER THE STANDPIPE IN A VERTICAL POSITION.
2. VALVE BOX TOP SHALL BE ADJUSTED TO MEET FINISHED GRADE.
3. PVC SHALL BE ONE CONTINUOUS PIECE—NO BELLS OR COUPLERS.
4. USE FOR 4" & 6" BLOW-OFF STANDPIPES AND FLUSH MOUNTED CATHODIC PROTECTION TEST STATIONS ONLY.

DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 PORTLAND STYLE VALVE BOX	SCALE	N.T.S.
DIV.			WATER				DATE	JAN.1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	514

NOTE:

SPECIFICATION
FOR THE STANDARD
WATER METER VAULT
ARE LOCATED ON
DETAIL 515D

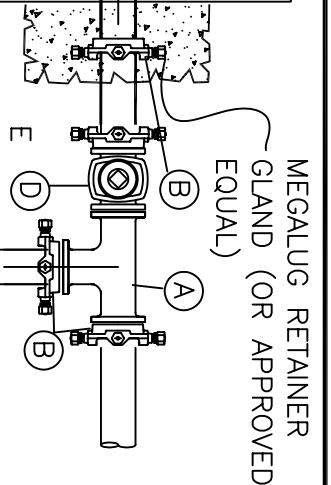
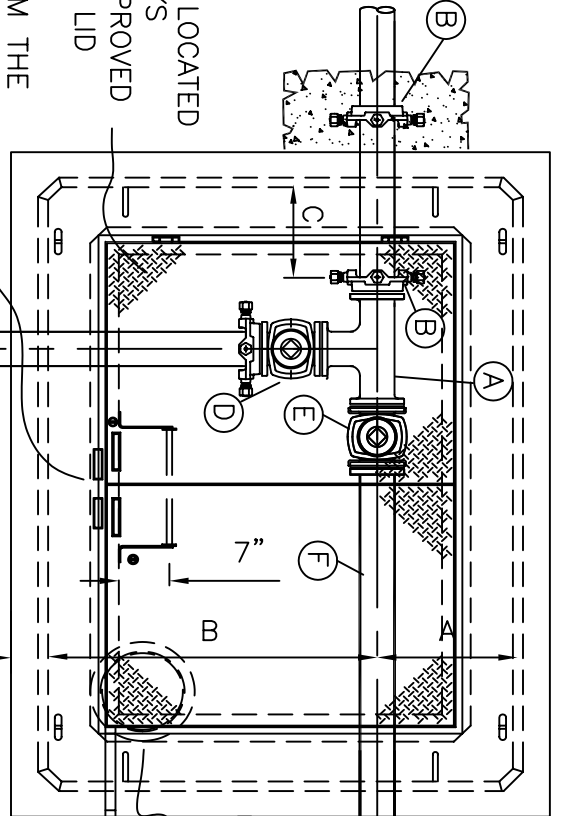
COAT ALL OUTSIDE
SURFACES OF CONC.
VAULT W/CRYSTAL SEAL
(OR APPROVED EQUAL)

WHENEVER VAULTS ARE LOCATED
IN PEDESTRAIN WALKWAYS
APPLY SLIPNOT (OR APPROVED
EQUAL) ON ALL VAULT LID
SURFACES.

VAULT LIDS FROM THE
MANUFACTURE WILL BE INSTALLED
W/CENTER LINE OFFSET UNLESS
SPECIFIED BY THE WATER ENGINEER

CORE DRILL OPENING
FOR PIPE AND SEAL
W/NON-SHRINK
WATERPROOF GROUT

3" GALVANIZED OR
EPOXY COATED "STAND-ON"
PIPE SUPPORT
(OR APPROVED EQUAL)



CORE DRILL 18"Ø HOLE IN BOTTOM
OF VAULT AWAY FROM MAIN FOR 12"Ø
x12" DEEP SUMP BY UTILITY VAULT
(OR APPROVED EQUAL) TO BE
PROVIDED BY CONTRACTOR DURING
VAULT INSTALLATION

MEGALUG RETAINER
GLAND (OR APPROVED
EQUAL)

PLAN
UTILITY VAULT ALUMINUM EXT.
LADDER (OR APPROVED EQUAL)

2" WEEP HOLE TO
DRAIN LID FRAME
TO DAYLIGHT
STRADEL BLOCK SEE
DTL 510

3/4" - MINUS
SELECT BACKFILL

1" MIN.
INSTALL PVC PIPING AT
BOTTOM OF SUMP BASIN
TO DRAIN METER VAULT
TO THE BACKFLOW VAULT

SECTION

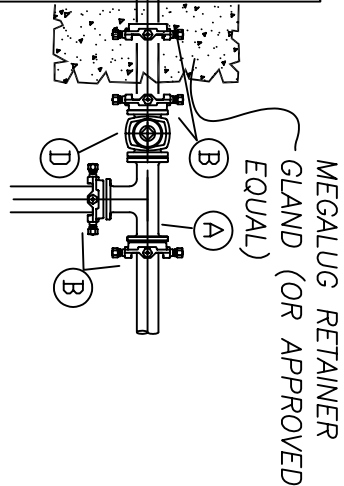
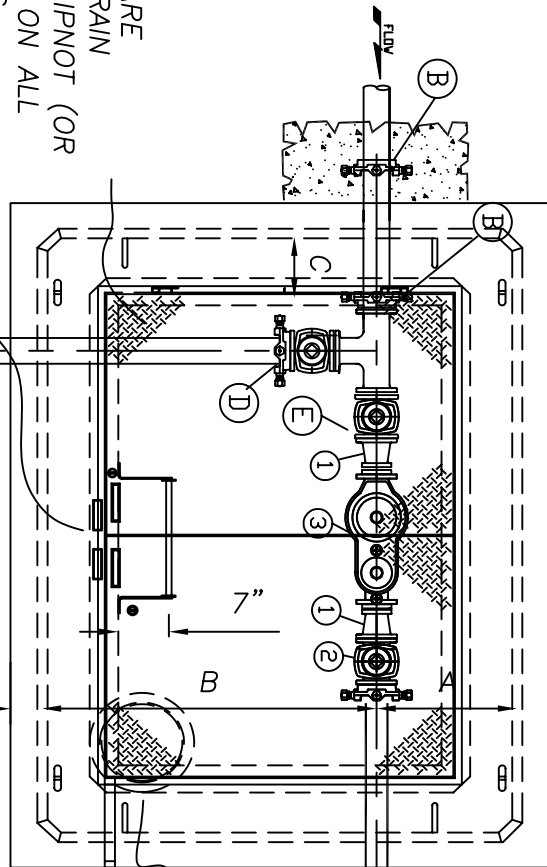
DRAWN	RWL
DIV.	WATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STANDARD HERSEY MCT2 COMPOUND
PRIVATE SIDE METER INSTALL-3"x3", 4"x4" & 6"x6"

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	515A

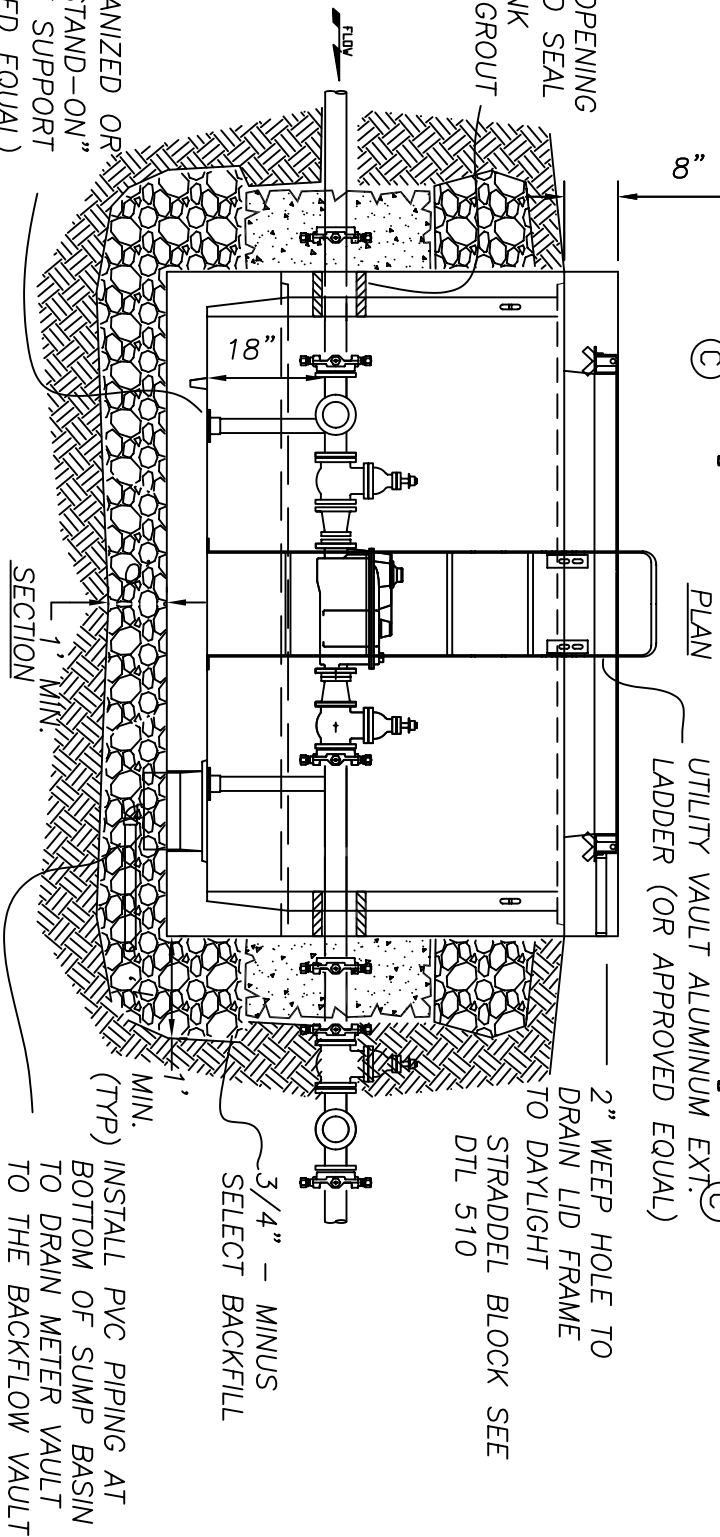
NOTE:
SPECIFICATION
FOR THE STANDARD
WATER METER VAULT
ARE LOCATED ON
DETAIL 515D

WHENEVER VAULTS ARE
LOCATED IN PEDESTRAIN
WALKWAYS APPLY SLIPNOT (OR
APPROVED EQUAL) ON ALL
VAULT LID SURFACES.



CORE DRILL 18"Ø HOLE IN BOTTOM
OF VAULT AWAY FROM MAIN FOR 12"Ø
x12" DEEP SUMP BY UTILITY VAULT
(OR APPROVED EQUAL) TO BE
PROVIDED BY CONTRACTOR DURING
VAULT INSTALLATION

CORE DRILL OPENING
FOR PIPE AND SEAL
W/NON-SHRINK
WATERPROOF GROUT



3" GALVANIZED OR
EPOXY COATED "STAND-ON"
PIPE SUPPORT
(OR APPROVED EQUAL)

SECTION

1" MIN.
(TYP) INSTALL PVC PIPING AT
BOTTOM OF SUMP BASIN
TO DRAIN METER VAULT
TO THE BACKFLOW VAULT

3/4" - MINUS
SELECT BACKFILL

2" WEEP HOLE TO
DRAIN LID FRAME
TO DAYLIGHT
STRADDEL BLOCK SEE
DTL 510

PLAN
UTILITY VAULT ALUMINUM EXT.
LADDER (OR APPROVED EQUAL)

DRAWN	RWL
DIV.	WATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STANDARD HERSEY MCT2 COMPOUND
CITY OF GRESHAM METER INSTALLATION - 3"x3"

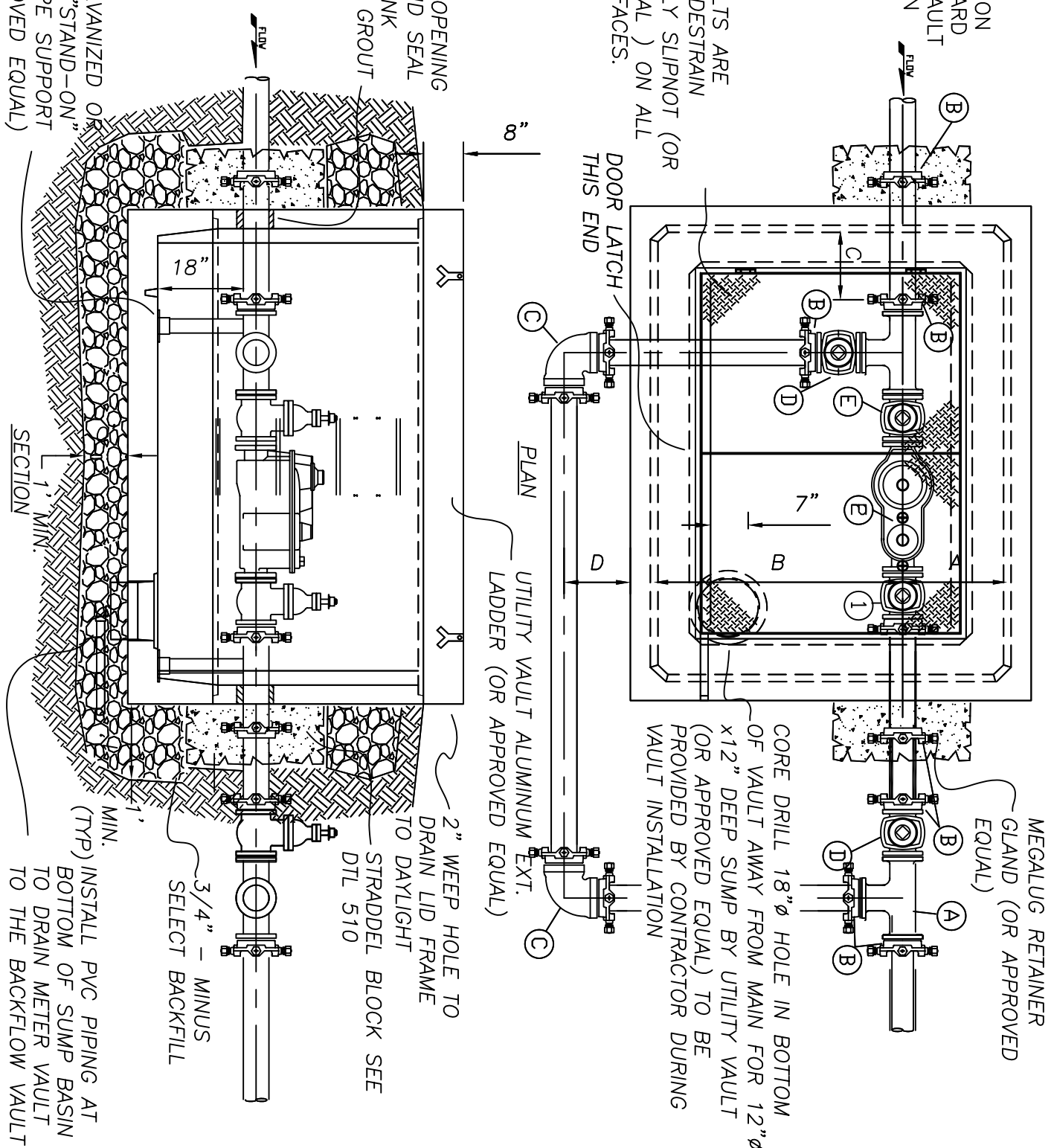
SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	515B

NOTE:
SPECIFICATION
FOR THE STANDARD
WATER METER VAULT
ARE LOCATED ON
DETAIL 515D

WHENEVER VAULTS ARE
LOCATED IN PEDESTRAIN
WALKWAYS APPLY SLIPNOT (OR
APPROVED EQUAL) ON ALL
VAULT LID SURFACES.

3" GALVANIZED OR
EPOXY COATED "STAND-ON"
PIPE SUPPORT
(OR APPROVED EQUAL)

CORE DRILL OPENING
FOR PIPE AND SEAL
W/NON-SHRINK
WATERPROOF GROUT



DRAWN	RWL
DIV.	WATER
REV.	DATE
	APPR.

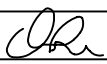
DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STANDARD HERSEY MCT2 COMPOUND
CITY OF GRESHAM METER INSTALLATION-4"x4" & 6"x6"

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	515C

SPECIFICATIONS			
METER	3" METER	4" METER	6" METER
INCOMING LINE SIZE	4"	4"	6"
BY-PASS LINE SIZE	4"	4"	6"
UTILITY VAULT NO.	687-COG (OR APPROVED EQUAL)	687-COG (OR APPROVED EQUAL)	612-COG (OR APPROVED EQUAL)
LID NO. (OR APPROVED EQUAL)	CHD-11AL PEDESTRAIN RATED DOORS	CHD-11AL PEDESTRAIN RATED DOORS	CHD-11AL PEDESTRAIN RATED DOORS
A	24" MIN.	24" MIN.	24" MIN.
B	36" MIN.	36" MIN.	36" MIN.
C	12" MIN.	12" MIN.	12" MIN.
D	24" MIN.	24" MIN.	24" MIN.
E	24" MIN.	24" MIN.	24" MIN.

FITTINGS & VALVES BY CONTRACTOR			
METERS	3"x3"	4"x4"	6"x6"
A	4" FLG TEE	4" FLG TEE	6" FLG TEE
B	4" MJxFLG ADAPTER	4" MJxFLG ADAPTER	6" MJxFLG ADAPTER
C	4" MJ 90° BEND	4" MJ 90° BEND	6" MJ 90° BEND
D	4" MJxFLG R.W. GATE VALVE	4" MJxFLG R.W. GATE VALVE	6" MJxFLG R.W. GATE VALVE
E	4" FLG R.W. GATE VALVE	4" FLG R.W. GATE VALVE	6" FLG R.W. GATE VALVE
F	4" FLGxPE CONTINUOUS D.I. PIPE	4" FLGxPE CONTINUOUS D.I. PIPE	6" FLGxPE CONTINUOUS D.I. PIPE

FITTINGS, VALVES & METER BY CITY			
METER	3"x4"	4"x4"	6"x6"
1	4"x3" FLG REDUCER	4" MJxFLG R.W. GATE VALVE	6" MJxFLG R.W. GATE VALVE
2	4" MJxFLG R.W. GATE VALVE	4" HERSEY/MCT METER (OR APPROVED EQUAL)	6" HERSEY/MCT METER (OR APPROVED EQUAL)
3	3" HERSEY/MCT METER (OR APPROVED EQUAL)		

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD HERSEY MCT2 COMPOUND METER SPECIFICATIONS – 3"x3", 4"x4" & 6"x6"	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
	RWL			DWG. NO. 515D

NOTE:

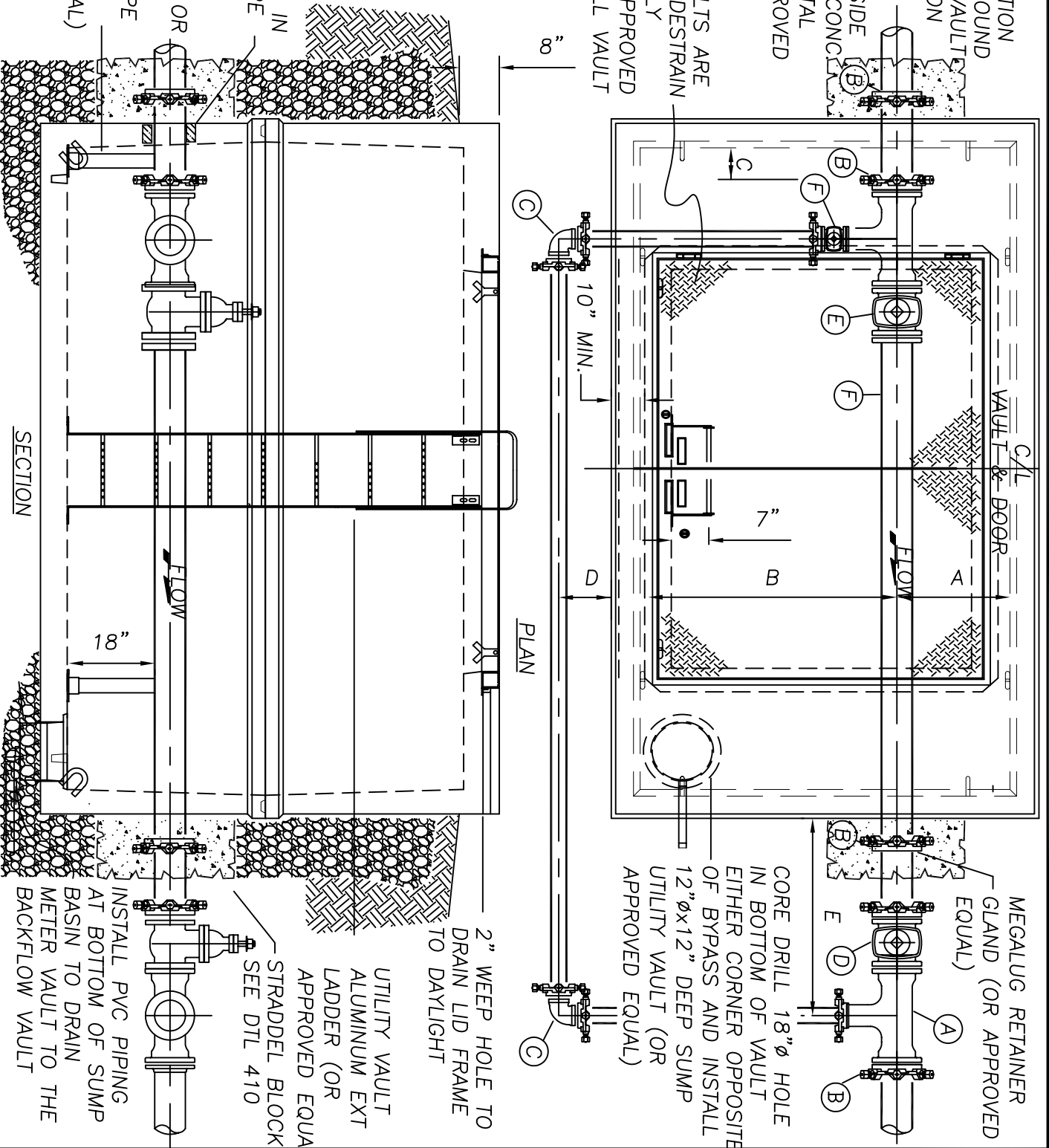
SPECIFICATION
FOR THE COMPOUND
WATER METER VAULTS
ARE LOCATED ON
DETAIL 5156

COAT ALL OUTSIDE
SURFACES OF CONC.
VAULT W/CRYSTAL
SEAL (OR APPROVED
EQUAL)

WHENEVER VAULTS ARE
LOCATED IN PEDESTRAIN
WALKWAYS APPLY
SLIPNOT (OR APPROVED
EQUAL) ON ALL VAULT
LID SURFACES.

SEAL W/NON
SHRINK GROUT
CORE OPENING IN
VAULT FOR PIPE

3" GALVANIZED OR
EPOXY COATED
"STAND-ON" PIPE
SUPPORT (OR
APPROVED EQUAL)



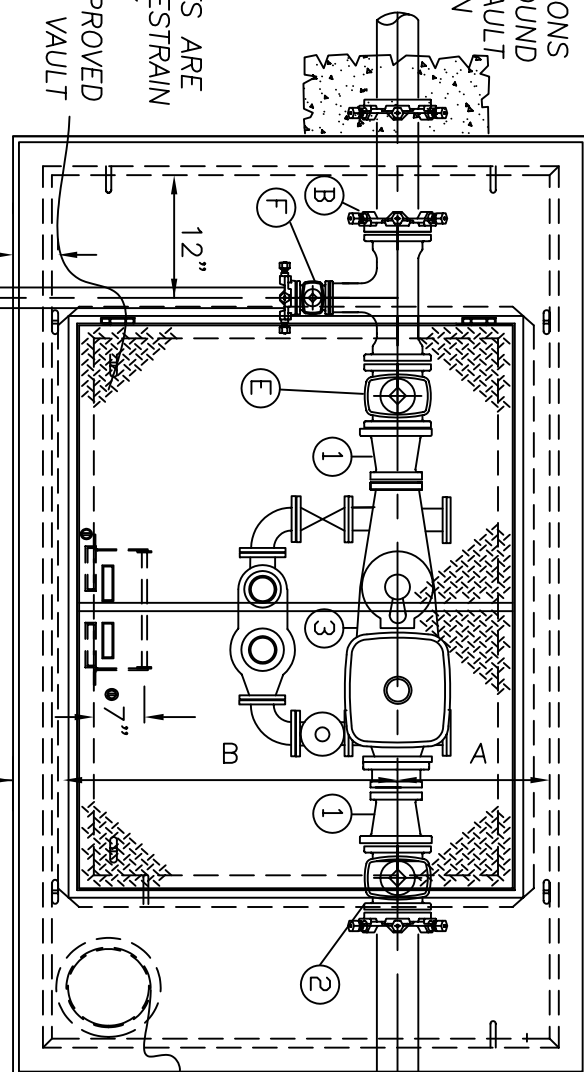
DRAWN	RWL
DIV.	WATER
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STANDARD HERSEY MCT2 COMPOUND
PRIVATE METER INSTALLATION - 4"x2", 6"x2" & 8"x4"

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	515E

NOTE:
SPECIFICATIONS
FOR THE COMPOUND
WATER METER VAULT
ARE LOCATED ON
DETAIL 515G

WHENEVER VAULTS ARE
LOCATED IN PEDESTRAIN
WALKWAYS APPLY
SLIPNOT (OR APPROVED
EQUAL) ON ALL VAULT
LID SURFACES.



MEGALOG RETAINER
GLAND (OR APPROVED
EQUAL)

CORE DRILL 18" Ø HOLE IN
BOTTOM OF VAULT AWAY
FROM MAIN FOR 12"Øx12"
DEEP SUMP BY UTILITY
VAULT (OR APPROVED
EQUAL) TO BE PROVIDED BY
CONTRACTOR DURING VAULT
INSTALLATION

2" WEEP HOLE TO
DRAIN LID FRAME
TO DAYLIGHT

UTILITY VAULT
ALUMINUM EXT
LADDER (OR
APPROVED EQUAL)

STRADDLE BLOCK
SEE DTL 510

INSTALL PVC PIPING AT
BOTTOM OF SUMP BASIN
TO DRAIN METER VAULT
TO THE BACKFLOW VAULT

PLAN

CORE DRILL
OPENING
FOR PIPE
AND SEAL
W/NON-SHRINK
WATERPROOF
GROUT

3" GALVANIZED OR
EPOXY COATED
"STAND-ON" PIPE
SUPPORT (OR
APPROVED EQUAL)

8" MIN.

10" MIN.

12"

7"

18"

SECTION

DRAWN		XX	
DIV.		WATER	
REV.	DATE	APPR.	
	RWL		

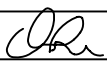
DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
STANDARD HERSEY MCT2 COMPOUND
C.O.G. METER INSTALLATION - 4"x2", 6"x3" & 8"x4"

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	515F

SPECIFICATIONS			
METER	4"x2"	6"x3"	8"x4"
INCOMING LINE SIZE	6"	8"	10"
BY-PASS LINE SIZE	4"	4"	6"
UTILITY VAULT	810-COG	712-COG	816-COG
SYRACUSE LID (OR APPROVED EQUAL)	CHD-11AL PEDESTRIAN RATED DOORS	CHD-11AL PEDESTRIAN RATED DOORS	CHD-11AL PEDESTRIAN RATED DOORS
A	24" MIN	24" MIN	24" MIN
B	36" MIN	36" MIN	36" MIN
C	12" MIN	12" MIN	12" MIN
D	24" MIN	24" MIN	26" MIN
E	24" MIN	28" MIN	30" MIN

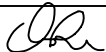
FITTINGS & VALVES BY CONTRACTOR			
METER	4"x2"	6"x3"	8"x4"
(A)	6"x4" FLG TEE	8"x4" FLG TEE	10"x6" FLG TEE
(B)	6" MJxFLG ADAPTER	8" MJxFLG ADAPTER	10" MJxFLG ADAPTER
(C)	4" MJ 90° BEND	4" MJ 90° BEND	4" MJ90° BEND
(D)	6" MJxFLG R.W. GATE VALVE	8" MJxFLG R.W. GATE VALVE	10" MJxFLG R.W. GATE VALVE
(E)	6" FLG R.W. GATE VALVE	8" FLG R.W. GATE VALVE	10" FLG R.W. GATE VALVE
(F)	4" MJxFLG R.W. GATE VALVE	4" MJxFLG R.W. GATE VALVE	6" MJxFLG R.W. GATE VALVE
(G)	6" FLGxPE CONTINUOUS D.I. PIPEL	8" FLGxPE CONTINUOUS D.I. PIPE	10" FLGxPE CONTINUOUS D.I. PIPE

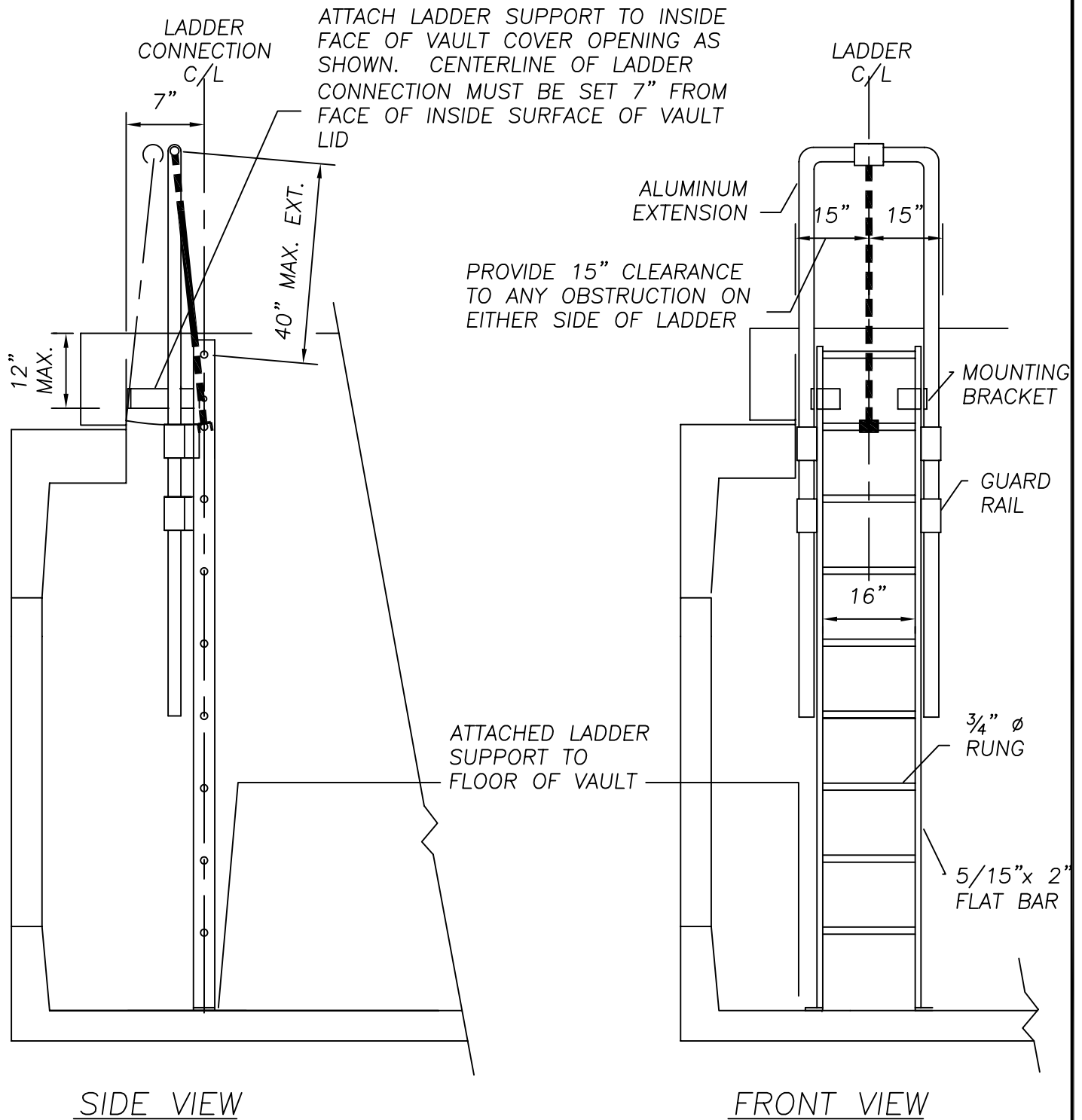
FITTING, VALVES & METER BY CITY			
METER	4"x2"	6"x3"	8"x4"
(1)	6"x4" FLG REDUCER	8"x6" FLG REDUCER	10"x8" FLG REDUCER
(2)	6" MJxFLG R.W. GATE VALVE	8" MJxFLG R.W. GATE VALVE	10" MJxFLG R.W. GATE VALVE
(3)	4"x2" HERSEY MFM/MCT2 COMPOUND METER (OR APPROVED EQUAL)	6"x3" HERSEY MFM/MCT2 COMPOUND METER (OR APPROVED EQUAL)	8"x4" HERSEY MFM/MCT2 COMPOUND METER (OR APPROVED EQUAL)


DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD HERSEY MFM/MCT2 COMPOUND METER 4"x2", 6"x3" & 8"x4" SPECIFICATIONS	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 515G

NOTES:

1. METER AND DOWNSTREAM VALVE TO BE INSTALLED BY THE CITY ONCE NEW PIPING AND FITTINGS HAVE BEEN TESTED AND ACCEPTED.
2. ALL VAULT WALL OPENINGS SHALL BE CORE DRILLED AND SEALED WITH NON-SHRINK GROUT.
3. TOP OF VAULT BE A MINIMUM 8" ABOVE FINISH GRADE.
4. INSTALL 4" DRAIN FROM BOTTOM OF VAULT FLOOR TO DAYLIGHT, TO BACKFLOW ASSEMBLY VAULT, TO STORM DRAIN SYSTEM OR TO APPROVED SUMP. IN NO CASE SHALL BACKFLOW VAULT DRAIN INTO METER VAULT.
5. VAULT SHALL BE CLEAN, DRY AND FREE OF DEBRIS PRIOR TO METER INSTALLATION
6. ALL MECHANICAL JOINTS SHALL BE RESTRAINED WITH "MEGALUG" RETAINER GLANDS OR APPROVED EQUAL.
7. SERVICE LINE INTO VAULT SHALL BE MECHANICALLY RESTRAINED FROM MAINLINE THROUGH VAULT.
8. ALL PIPING TO BE BACKFILLED AS DESCRIBED & SHOWN IN STANDARD DETAIL 502.
9. INSTALL A MIN. OF 3 PIPE SUPPORTS IN VAULT (GRINNELL NO. 264 ELCEN NO. 59 OR APPROVED EQUAL).
10. ALL PIPING AND FITTINGS IN VAULT SHALL BE LEVEL AND MINIMUM OF 18" AND A MAX. 42" ABOVE THE FLOOR OF VAULT.
11. ONLY APPROVED RESILIENT WEDGE VALVES ARE ALLOWED.
12. ALL VAULT LIDS SHALL BE EQUIPPED WITH SYRACUSE OR BILCO LIDS (OR AN APPROVED EQUAL) SEE DETAILS 515D AND 516F FOR LID SIZES FOR VARIOUS UTILITY VAULTS.
13. ALL VAULTS SHALL BE EQUIPPED WITH OHSA APPROVED UTILITY VAULT ALUMINUM EXT. LADDER(OR AN APPROVED EQUAL).
14. PIPE BETWEEN THE TWO TEES SHALL BE ONE LEVEL CONTINUOUS PIECE OF PIPE.
15. ALL FITTINGS, VALVES AND PIPING THROUGH ENTIRE VAULT SHALL BE LEVEL AT COMPLETION OF INSTALLATION.
16. VAULT PIPE OPENINGS SHALL BE SEALED WITH NON-SHRINK GROUT. "CRYSTAL SEAL" (OR APPROVED EQUAL) AT MANUFACTURE.
17. ON THE EXTERIOR SURFACES OF ALL VAULTS WILL MAINTAIN A 2 FOOT CLEARANCE FROM OUTSIDE WALL OF VAULT TO EXCAVATED BANK OF EARTH AND WILL BE BACKFILLED WITH $\frac{3}{4}$ " MINUS SELECT BACKFILL.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.	STANDARD HERSEY COMPOUND METER INSTALLATION NOTES	APPR. 
				DWG. NO. 515H



DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 GALVANIZED LADDER W/ALUMINUM EXT. STANDARD FOR ALL WATER VAULTS	SCALE	N.T.S.	
DIV.			WATER				DATE	JAN.1, 2006	
REV.	DATE	APPR.					APPR.		
							DWG. NO.	5151	

CITY OF GRESHAM
CROSS CONNECTION PROGRAM

BACKFLOW ASSEMBLY AND VAULT
INSTALLATION STANDARDS

- * DOUBLE CHECK VALVE ASSEMBLY
- * DOUBLE CHECK DETECTOR ASSEMBLY
- * REDUCED PRESSURE (R.P.) ASSEMBLY



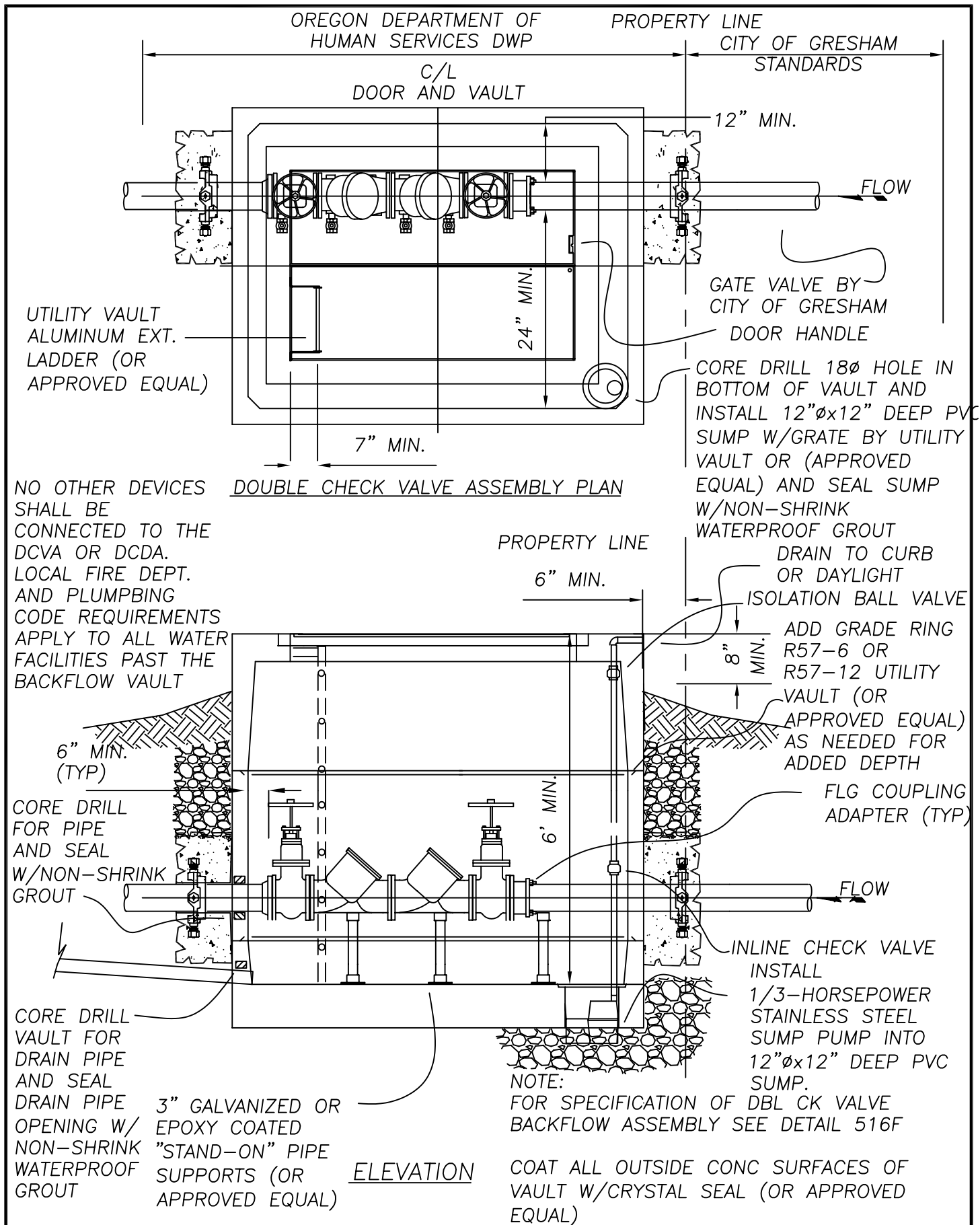
CONTACTS


DEPARTMENT

PHONE NO.

ENGINEERING	618-2633
OPERATIONS	618-2626
PLUMBING INSPECTION	618-2830
FIRE DEPARTMENT	618-2573

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 BACKFLOW ASSEMBLY	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. <i>OR</i>
				DWG. NO. 516A



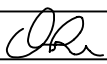
DRAWN			RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 DOUBLE CHECK VALVE (DETECTOR) BACKFLOW ASSEMBLY			SCALE		N.T.S.	
DIV.			WATER						DATE		JAN., 2006	
REV.	DATE	APPR.	APPR.									
					DWG. NO. 516B							

CITY OF GRESHAM
REQUIREMENTS FOR BACK FLOW PREVENTION ASSEMBLY
INSTALLATIONS ON 1 1/2" AND LARGER DOMESTIC SERVICES,
IRRIGATION SERVICES AND FIRE LINE SERVICES

AN APPROVED BACK FLOW PREVENTION ASSEMBLY IS REQUIRED ON ALL 1 1/2" AND LARGER DOMESTIC METER SIZE SERVICES, PLUS ALL DEDICATED IRRIGATION AND ALL FIRE LINE SYSTEMS. AN ASSEMBLY WILL BE APPROVED BY THE CITY OF GRESHAM ONLY IF THE DEPT. OF HUMAN SERVICES HAS APPROVED ITS USE AS A BACK FLOW ASSEMBLY, AND THE ASSEMBLY IS TESTABLE. THE ASSEMBLY SHALL BE INSTALLED AT THE PROPERTY LINE. WHEN IT IS NOT POSSIBLE TO LOCATE THE ASSEMBLY AT THE PROPERTY LINE, THE PROPOSED LOCATION MUST BE APPROVED BY THE WATER DIVISION ENGINEER BEFORE INSTALLATION. A WATER SERVICE SHALL NOT BE TURNED ON UNTIL ALL REQUIRED BACK FLOW PREVENTION ASSEMBLIES ARE INSTALLED, INSPECTED, TESTED, AND REGISTERED WITH THE CITY OF GRESHAM (SEE NOTE 8 BELOW). COST OF ALL INSTALLATIONS, INCLUDING ALL COST OF INITIAL INSPECTION AND TESTING FEES, SHALL BE THE RESPONSIBILITY OF THE CUSTOMER. THE CUSTOMER WILL BE RESPONSIBLE FOR ALL MAINTENANCE AND TESTING OF THE ASSEMBLY AND VAULT WHEN USED.

CONSTRUCTION AND DESIGN STANDARDS FOR WATER FACILITIES

1. ALL PIPE WILL BE INSTALLED TO THE CITY OF GRESHAM'S PUBLIC WORKS STANDARDS.
2. THE CITY OF GRESHAM WILL BE FURNISHED WITH THREE SETS OF PLANS AND SPECIFICATIONS. THE PLANS WILL BE DRAWN AT A SCALE OF 1"=20' FOR PLAN CHECK. ONE SET OF REVISED PLANS WILL BE RETURNED TO THE ENGINEER FOR REVISIONS.
3. THE CONTRACTOR WILL KEEP ONE SET OF APPROVED PLANS AT THE CONSTRUCTION SITE.
4. THE ENGINEER WILL FURNISH THE CITY OF GRESHAM 48-HOUR NOTICE PRIOR TO CONSTRUCTION.
5. WATER FACILITIES WILL BE INSTALLED IN THE PRESENCE OF THE CITY OF GRESHAM'S INSPECTOR. THE INSPECTOR SHALL HAVE ACCESS TO THE CONSTRUCTION SITE AT ALL TIMES.
6. NEW MAINS ARE TO BE PRESSURE TESTED AND DISINFECTED BY THE CONTRACTOR AND PROVEN TO BE BACTERIOLOGIC ALLY SAFE PRIOR TO PLACING NEW MAINS IN SERVICE AND PRIOR TO CONNECTION TO CITY FACILITIES.
7. UPON COMPLETION OF THE WATER FACILITY, THE ENGINEER WILL NOTIFY THE CITY OF GRESHAM 48 HOURS IN ADVANCE OF DESIRED, FINAL INSPECTION.
8. CONTRACTOR MUST COORDINATE BACK FLOW ASSEMBLY TEST WITH GRESHAM WATER QUALITY DEPT. (WATER OPERATION TELEPHONE NO. (503)618-2626), TO RECEIVE SERVICE TO PROPERTY. METER STOPS AND VALVES TO REMAIN LOCKED & OFF UNTIL THAT TIME OF COORDINATION AND APPROVED TEST.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 BACKFLOW ASSEMBLY	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 516C

DOUBLE CHECK VALVE (DETECTOR) ASSEMBLY

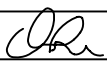
BACK FLOW ASSEMBLY INSTALLATION STANDARD

TO ENSURE PROPER OPERATION AND ACCESSIBILITY OF ALL BACK FLOW PREVENTION ASSEMBLIES, THE FOLLOWING REQUIREMENTS SHALL APPLY TO INSTALLATION OF THESE ASSEMBLIES UNLESS SPECIFICALLY APPROVED BY THE WATER DIVISION ENGINEER/SUPERINTENDENT. THE CITY OF GRESHAM PUBLIC WORKS STANDARDS AND CHAPTER 5 OF THE CITY CODE WILL TAKE PRECEDENCE IN DESIGN AND INSTALLATION.

1. NO PART OF THE BACKFLOW PREVENTION ASSEMBLY SHALL BE SUBMERGED IN WATER OR INSTALLED IN A LOCATION SUBJECT TO FLOODING. IF INSTALLED IN A VAULT OR CHAMBER, ADEQUATE DRAINAGE SHALL BE PROVIDED ONTO OWNER'S PROPERTY BY EITHER DRAINAGE TO DAYLIGHT OR BY SUMP PUMP TO DAYLIGHT. TEST COCKS SHALL BE PLUGGED. THE PLUGS SHALL NOT BE OF DISSIMILAR METALS
2. THE ASSEMBLY MUST BE PROTECTED FROM FREEZING AND OTHER SEVERE WEATHER CONDITIONS.
3. ONLY ASSEMBLIES APPROVED FOR VERTICAL INSTALLATION MAY BE INSTALLED VERTICALLY.
4. THE ASSEMBLY SHALL BE READILY ACCESSIBLE WITH ADEQUATE ROOM FOR MAINTENANCE AND TESTING. ASSEMBLIES 2 INCHES AND SMALLER SHALL HAVE AT LEAST A 12-INCH CLEARANCE BELOW AND ON BOTH SIDES OF THE ASSEMBLY; AND IF LOCATED IN A VAULT, THE TOP OF THE ASSEMBLY SHALL BE BETWEEN 18 AND 24 INCHES BELOW GRADE.

ALL ASSEMBLIES LARGER THAN 2 INCHES SHALL HAVE A 12-INCH CLEARANCE ON THE BACKSIDE, A 24-INCH CLEARANCE ON THE TEST-COCK SIDE, AND 12 INCH BELOW THE ASSEMBLY. ADEQUATE CLEARANCE (3 INCHES MIN.) MUST BE MAINTAINED ABOVE O.S. & Y. GATE-VALVE STEM. HEADROOM OF 6'-0" IS REQ'D IN VAULTS. ACCESS TO THE ASSEMBLIES AND TO ANY VAULT OR CHAMBER SHALL REMAIN CLEAR AT ALL TIMES. AN OR/OSHA APPROVED CHAMBER LADDER THAT EXTENDS 3 FT. ABOVE SURFACE OF VAULT SHALL BE INSTALLED.

5. NO POST INDICATING VALVES ARE ALLOWED TO BE INSTALLED DIRECTLY ON DOUBLE CHECK DETECTOR ASSEMBLIES.
6. ONLY APPROVED DOUBLE CHECK DETECTOR ASSEMBLIES ARE TO BE USED FOR SYSTEM CONTAINMENT ON FIRE LINE SERVICES IN THE CITY OF GRESHAM. THE METER ON BYPASS ASSEMBLY SHALL READ IN CUBIC FEET.
7. IF A FIRE LINE FLOW, OR TAMPER SWITCH IS INSTALLED, IT MUST BE CONNECTED TO A MONITORED FIRE DETECTION SYSTEM APPROVED BY THE FIRE MARSHAL. NO INSTALLATION WILL MODIFY THE BACK FLOW ASSEMBLY OR INTERFERE WITH ITS OPERATION OR MAINTENANCE.
8. ALL BACK FLOW ASSEMBLIES SHALL BE INSTALLED AT THE SERVICE CONNECTION TO THE PREMISES PER OREGON ADMINISTRATIVE RULES 333-61-070, CROSS CONNECTION CONTROL REQUIREMENTS, UNLESS SPECIFICALLY APPROVED BY THE WATER DIVISION MANAGER. (SERVICE CONNECTION - A LOCATION WHERE THE PUBLIC WATER FACILITIES END AT OR NEAR THE PROPERTY LINE)
9. ALL PIPE BETWEEN MAIN AND ASSEMBLY SHALL BE RESTRAINED. USE "MEGALUG" OR APPROVED EQUAL RETAINER GLANDS ON MJ FITTINGS AND "FIELD-LOK" OR APPROVED EQUAL GASKETS ON BELL JOINTS. UNI-FLANGE ADAPTERS MAY BE USED IN VAULTS.
10. APPROVED BACK FLOW ASSEMBLY MAY NOT BE MODIFIED IN ANY WAY FROM WHICH IT WAS MANUFACTURED, TESTED AND APPROVED.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 DOUBLE CHECK VALVE (DETECTOR) BACKFLOW ASSEMBLY	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 516D

REDUCED PRESSURE (R.P.) PRINCIPLE BACKFLOW PREVENTION ASSEMBLY (R.P.)

INSTALLATION STANDARD

AS WELL AS IN THE PREVIOUSLY STATED INSTALLATION STANDARDS, THESE INSTALLATION STANDARDS SHALL APPLY TO THE INSTALLATION OF R.P. ASSEMBLIES:

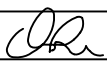
R.P.'S SHALL BE UTILIZED AT PREMISES WHERE A SUBSTANCE IS HANDLED THAT WOULD BE HIGH HAZARD TO HEALTH IF INTRODUCED INTO THE POTABLE WATER SYSTEM. THE R.P. IS NORMALLY USED IN LOCATION WHERE AND AIR GAP IS IMPRACTICAL. THE R.P. IS EFFECTIVE AGAINST BOTH BACKSHIPONAGE AND BACKPRESSURE.

1. R.P.'S MUST BE SIZED TO PROVIDE AN ADEQUATE SUPPLY OF WATER AND PRESSURE FOR THE PREMISES BEING SERVED. FLOW CHARACTERISTICS ARE NOT STANDARD. CONSULT MANUFACTURER'S SPECIFICATIONS FOR SPECIFIC PERFORMANCE DATA.
2. PREMISES WHERE INTERRUPTION OF WATER SUPPLY IS CRITICAL SHOULD BE PROVIDED WITH TWO ASSEMBLIES INSTALLED IN PARALLEL. THEY SHOULD BE SIZED IN SUCH A MANNER THAT EITHER ASSEMBLY WILL PROVIDE THE MINIMUM WATER REQUIREMENTS WHILE THE TWO TOGETHER WILL PROVIDE THE MAXIMUM FLOW REQUIRED.
3. BYPASS LINES ARE PROHIBITED. PIPE FITTINGS WHICH COULD BE USED FOR CONNECTING A BYPASS LINE SHALL NOT BE INSTALLED.
4. THE ASSEMBLY SHALL BE READILY ACCESSIBLE FOR TESTING AND MAINTENANCE AND SHALL BE LOCATED IN AN AREA WHERE WATER DAMAGE TO BUILDING OR FURNISHINGS WOULD NOT OCCUR FROM RELIEF VALVE DISCHARGE. AN APPROVED AIR GAP FUNNEL ASSEMBLY MAY BE USED TO DIRECT MINOR DISCHARGES AWAY FROM THE ASSEMBLY; THIS ASSEMBLY WILL NOT CONTROL FLOW IN A CONTINUOUS RELIEF SITUATION. DRAIN LINES TO ACCOMMODATE FULL RELIEF VALVE DISCHARGE FLOW SHALL BE REQUIRED.

R.P.'S SHALL BE INSTALLED ABOVE GRADE IN WELL DRAINED AREA, BUT MAY BE INSTALLED BELOW GRADE BY APPROVAL OF WATER DIVISION ENGINEER BEFORE INSTALLATION, IF AN ADEQUATE DRAIN BY GRAVITY THROUGH A "BORESIGHT" DRAIN TO DAYLIGHT IS PROVIDED.

ENCLOSURES SHALL BE DESIGNED FOR READY ACCESS AND SIZED TO ALLOW FOR THE MINIMUM CLEARANCES ESTABLISHED BELOW. REMOVABLE PROTECTIVE ENCLOSURES ARE TYPICALLY INSTALLED ON THE SMALLER ASSEMBLIES. BORE SIGHTED DAYLIGHT DRAIN PORTS MUST BE PROVIDED TO ACCOMMODATE FULL PRESSURE DISCHARGE FROM THE ASSEMBLY.

ALL ASSEMBLIES LARGER THAN 2 INCHES SHALL HAVE A MINIMUM OF 12 INCHES CLEARANCE ON THE BACK SIDE, 24 INCHES CLEARANCE ON THE TEST COCK SIDE, AND RELIEF VALVE OPENING SHALL BE AT LEAST 12 INCHES PLUS NOMINAL SIZE OF ASSEMBLY ABOVE THE FLOOR OR HIGH TEST POSSIBLE WATER LEVEL WHICHEVER IS HIGHER. HEADROOM OF 6 FEET IS REQUIRED IN VAULTS. A MINIMUM ACCESS OPENING OF 36"x72" INCHES SQUARE IS REQUIRED ON ALL VAULT LIDS. A CHAMBER LADDER MEETING OSHA REQUIREMENTS SHALL BE PERMANENTLY INSTALLED IN THE VAULT, UNLESS A SIDE ENTRY ENCLOSURE IS USED.

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 REDUCED PRESURE BACKFLOW ASSEMBLY	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 516E

REDUCED PRESSURE (R.P.) PRINCIPLE BACKFLOW PREVENTION ASSEMBLY (R.P.)
INSTALLATION STANDARD

ASSEMBLIES INSTALLED MORE THAN 5 FEET ABOVE FLOOR LEVEL MUST HAVE A SUITABLE PLATFORM FOR USE BY TESTING OR MAINTENANCE PERSONNEL.

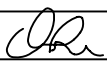
5. THE ASSEMBLY MUST BE PROTECTED FROM FREEZING AND OTHER SEVERE WEATHER CONDITIONS.
6. ONLY R.P. DEVICES APPROVED FOR VERTICAL INSTALLATION WILL BE ACCEPTED.
7. THE PROPERTY OWNER ASSUMES ALL RESPONSIBILITY FOR LEAKS AND DAMAGE. THE OWNER SHALL ALSO KEEP THE VAULT REASONABLY FREE OF SILT AND DEBRIS.
8. VARIANCES FROM THESE REGULATIONS WILL BE EVALUTED ON A CASE-BY-CASE BASIS. ANY DEVIATIONS MUST HAVE PRIOR WRITTEN APPROVAL OF THE WATER DIVISION ENGINEER PRIOR TO INSTALLATION.
8. APPLY CRYSTAL SEAL (OR APPROVED EQUAL) ON ALL OUTSIDE SURFACES OF PROPOSED CONC. VAULTS

END OF R.P. INSTALLATION STANDARD

VAULT SIZING CHART FOR DOUBLE CHECK		
SIZE	VAULT*	VAULT LID *
3"	577-LA UTILTIY VAULT (OR APPROVED EQUAL)	2-332P UTILITY VAULT (OR APPROVED EQUAL) CENTER OFFSET
4"	577-LA UTILITY VAULT (OR APPROVED EQUAL)	2-332P UTILITY VAULT (OR APPROVED EQUAL) CENTER OFFSET
6"	676-WA UTILITY VAULT (OR APPROVED EQUAL)	2-332P UTILITY VAULT (OR APPROVED EQUAL) CENTER OFFSET
8"	687-WA UTILITY VAULT (OR APPROVED EQUAL)	2-332P UTILITY VAULT (OR APPROVED EQUAL) CENTER OFFSET
10"	5106-WA UTILITY VAULT (OR APPROVED EQUAL)	2-332P UTILITY VAULT (OR APPROVED EQUAL) CENTER OFFSET

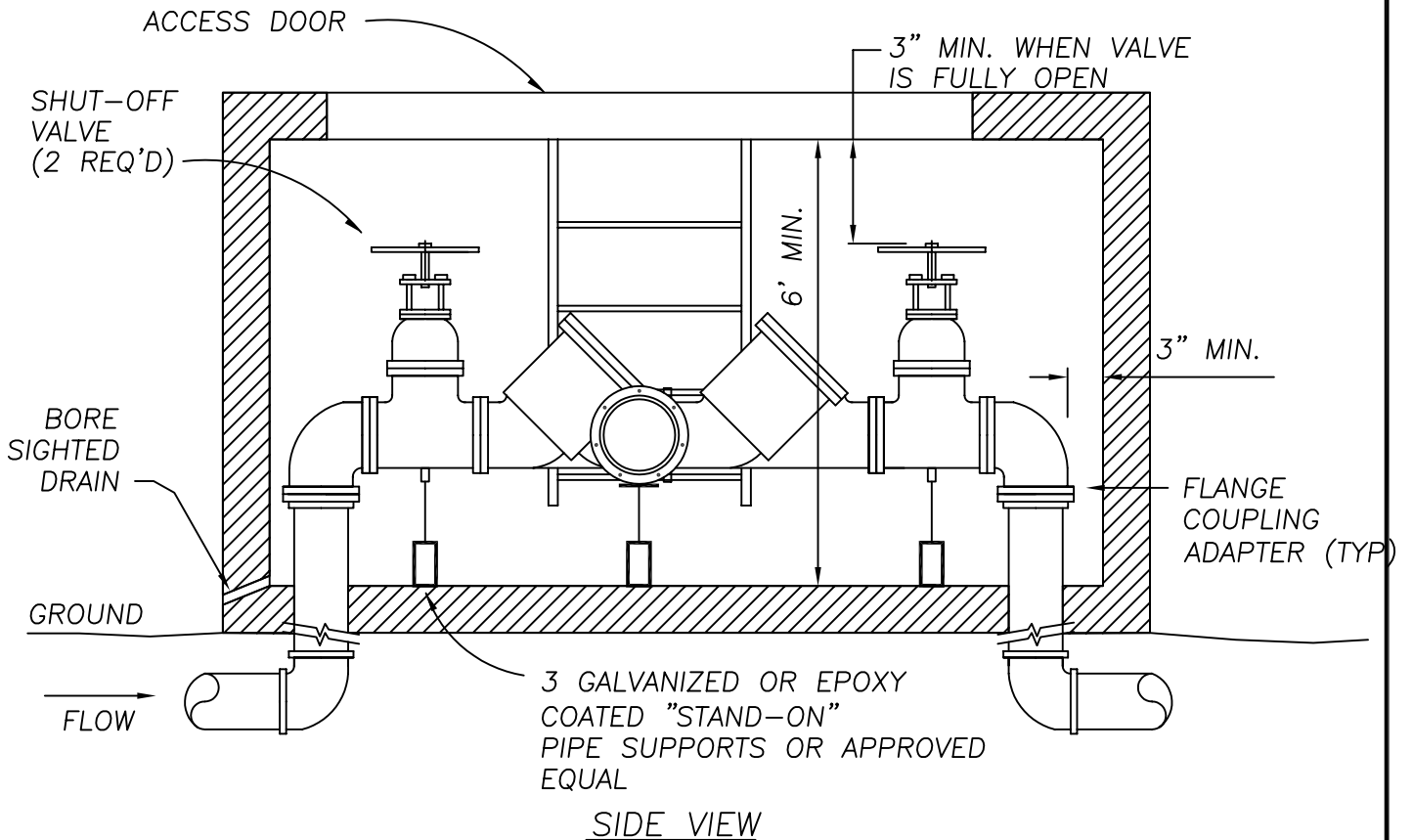
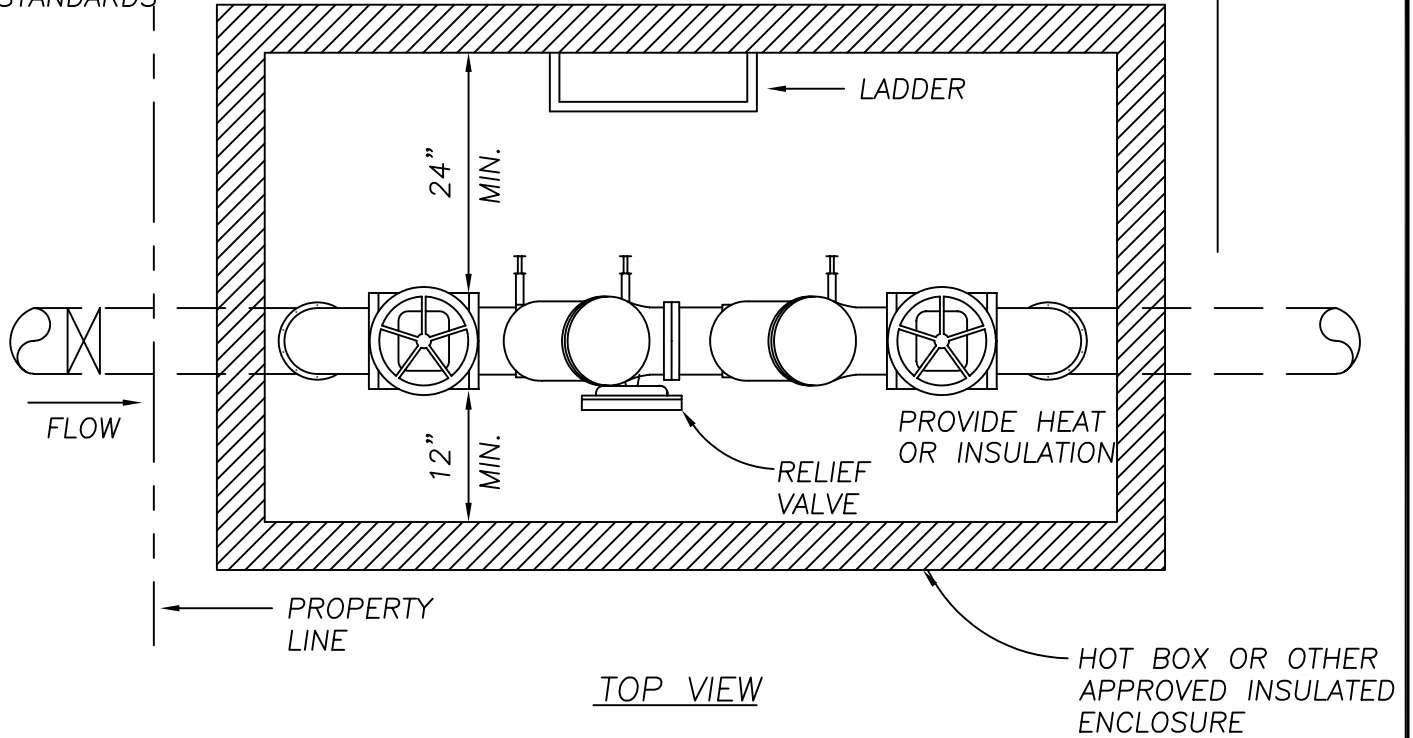
NOTE:

FOR ALL BACK FLOW VAULTS ADD 57R-6 AND/OR 57R-12
 RISER TO ACCOMODATE EXTRA DEPTHS DUE TO METER VAULT
 DRAINING TO BACK FLOW VAULTS

DRAWN RWL			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 BACKFLOW ASSEMBLY SPECIFICATIONS	SCALE N.T.S.
DIV. WATER				DATE JAN.1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 516F

DEPARTMENT OF HUMAN SERVICES
APPROVED ASSEMBLY
AND INSTALLATION

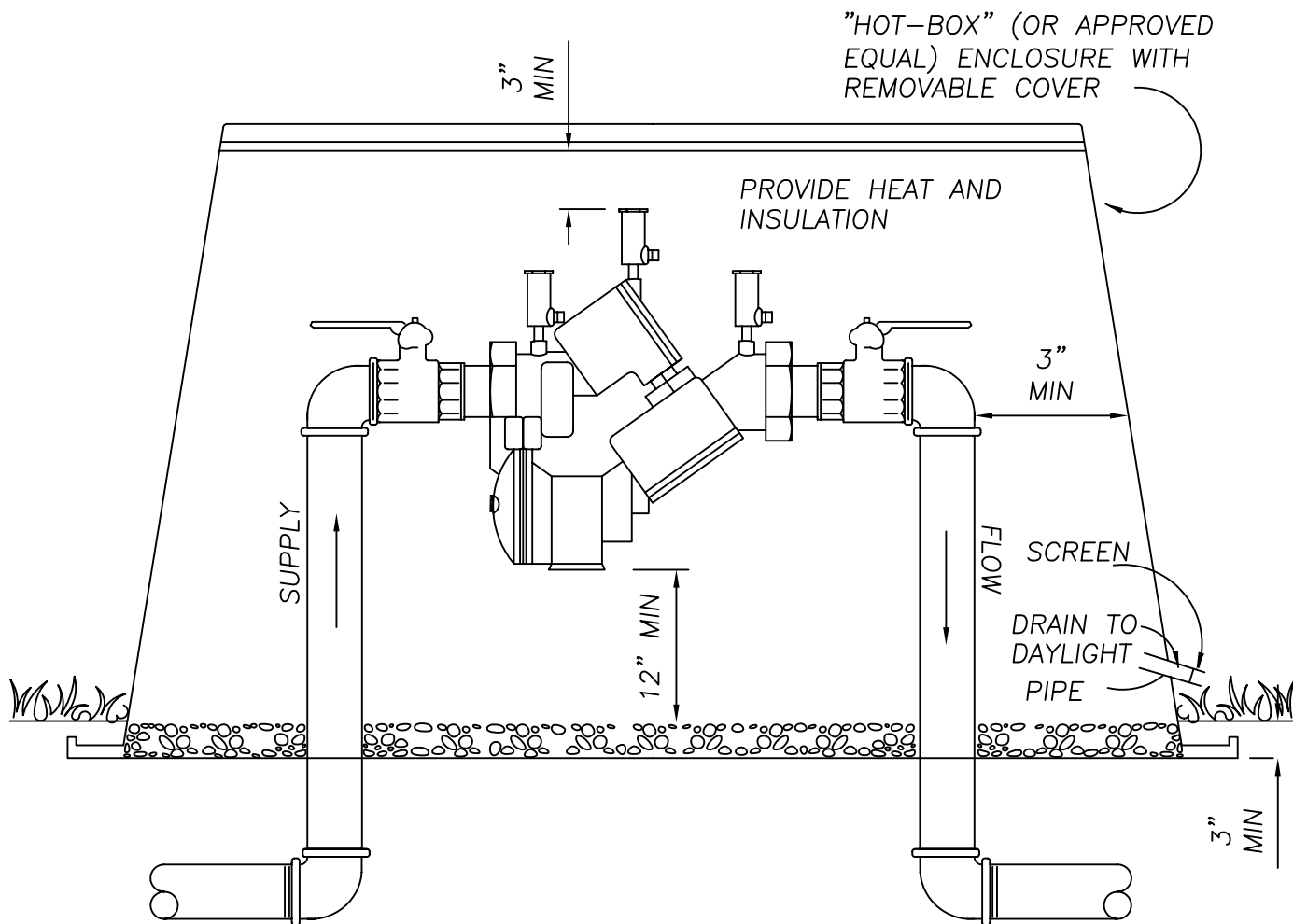
CITY OF
GRESHAM
STANDARDS



DRAWN	RWL	
DIV.	WATER	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
REDUCED PRESSURE PRINCIPLE ASSEMBLY
3" AND LARGER

SCALE N.T.S.
DATE JAN.1, 2006
APPR. *OR*
DWG. NO. 516G



DRAWN RWL		
DIV. WATER		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
REDUCED PRESSURE PRINCIPLE SMALL ASSEMBLY		
2 1/2" AND SMALLER		

SCALE	N.T.S.
DATE	JAN.1, 2006
APPR.	<i>OR</i>
DWG. NO.	516H

SUMP PUMP DRAIN LINE
TO CURB OR DAYLIGHT

ADD EXTRA GRADE RING FOR THE BACK
FLOW VAULT AS NEEDED TO MAINTAIN A
DEEPER DEPTH TO ACCOMMODATE
DRAINAGE FROM METER OR COMPOUND
METER VAULT SEE DETAIL 516F.

8" MIN.

NOTE:

PVC DRAIN PIPE
TO BE SIZED BY
WATER ENGINEER

METER VAULT

MAINTAIN MIN. 1% SLOPE
OF PVC PIPE FROM THE
SUMP OF METER VAULT
TO THE BACKFLOW
VAULT AS SHOWN

BACKFLOW VAULT

CORE DRILL HOLES IN
BACKFLOW VAULTS TO
ACCOMMODATE PVC DRAIN
PIPE FROM METER
VAULT. SEE DETAIL
516B FOR DRAINAGE
REQUIREMENTS OF
BACKFLOW VAULT

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

DRAINAGE ROUTE
BETWEEN METER AND BACKFLOW VAULTS

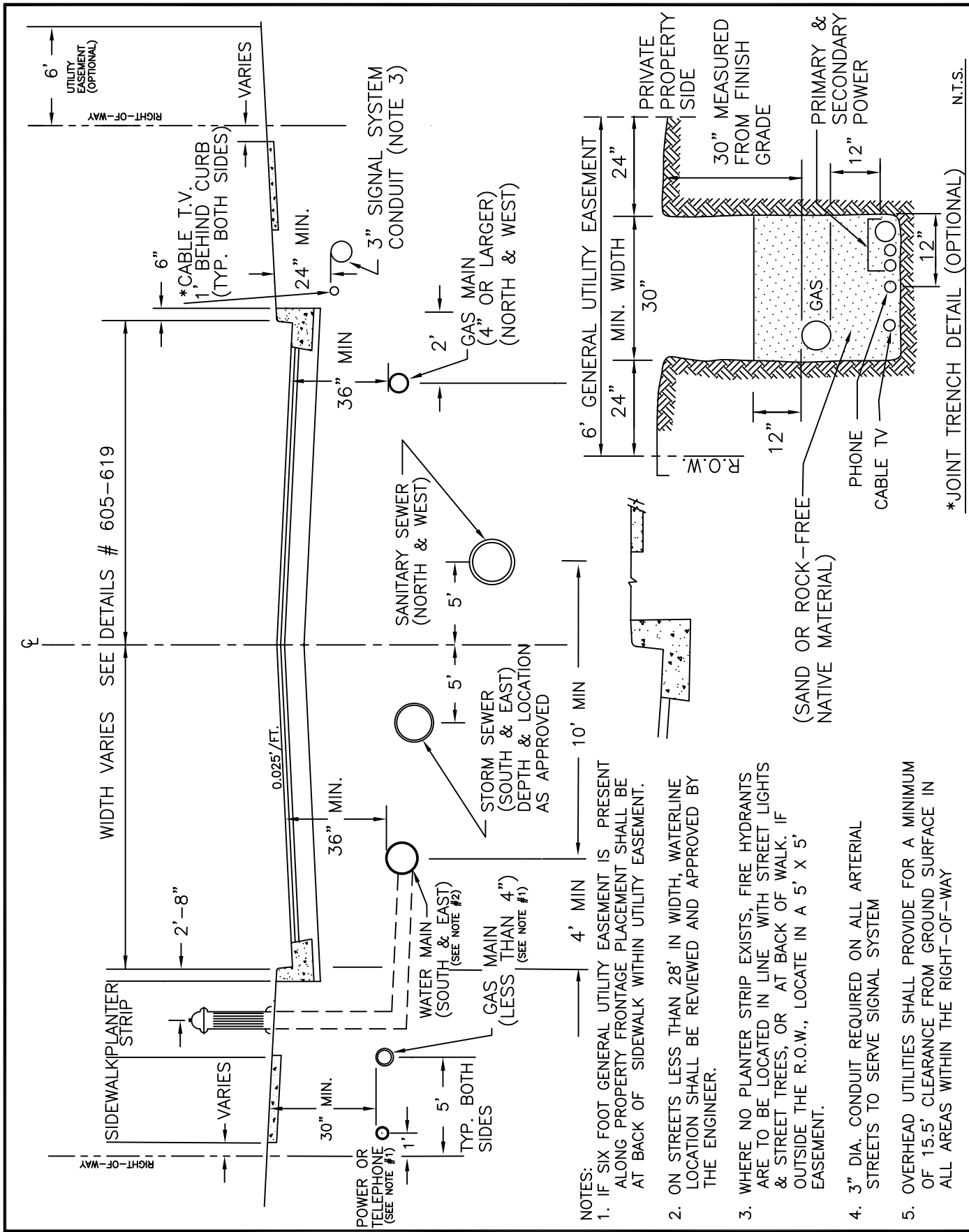
SCALE N.T.S.


DATE JAN.1, 2006

APPR. *OR*

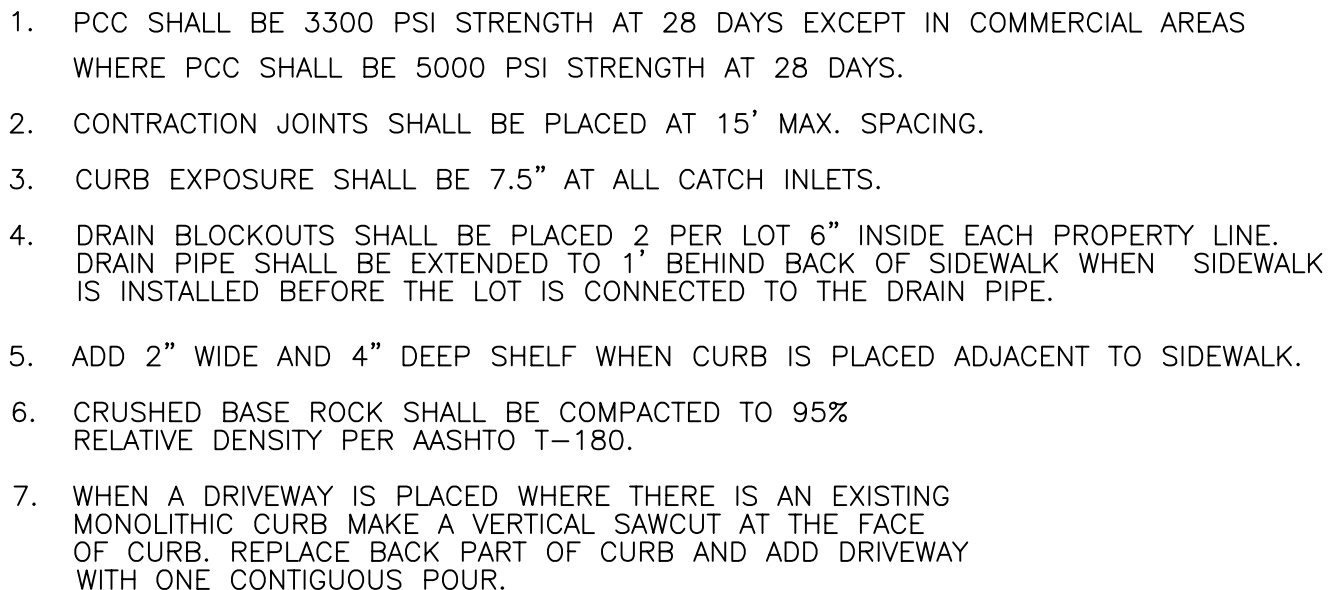
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DRAWN		RWL
DIV.		WATER
REV.	DATE	APPR.

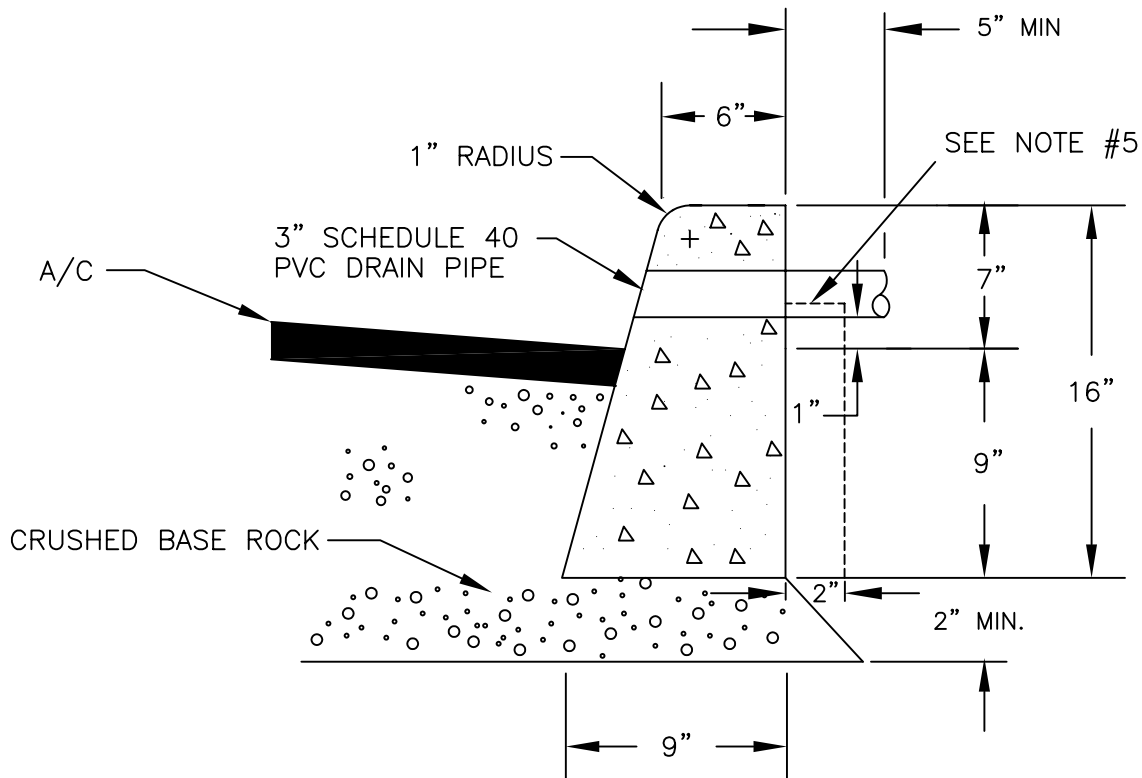


DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 601
			TYPICAL UTILITY PLACEMENT DETAIL	


*JOINT TRENCH DETAIL (OPTIONAL) N.T.S.



DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 MONOLITHIC CURB AND GUTTER	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 602

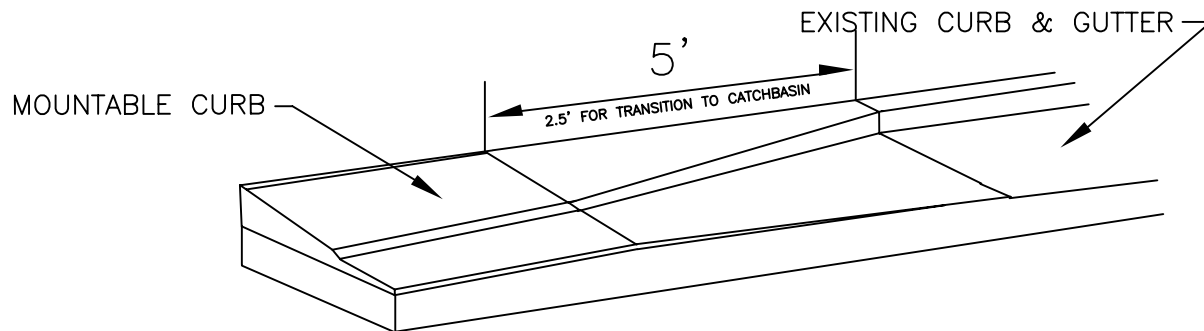
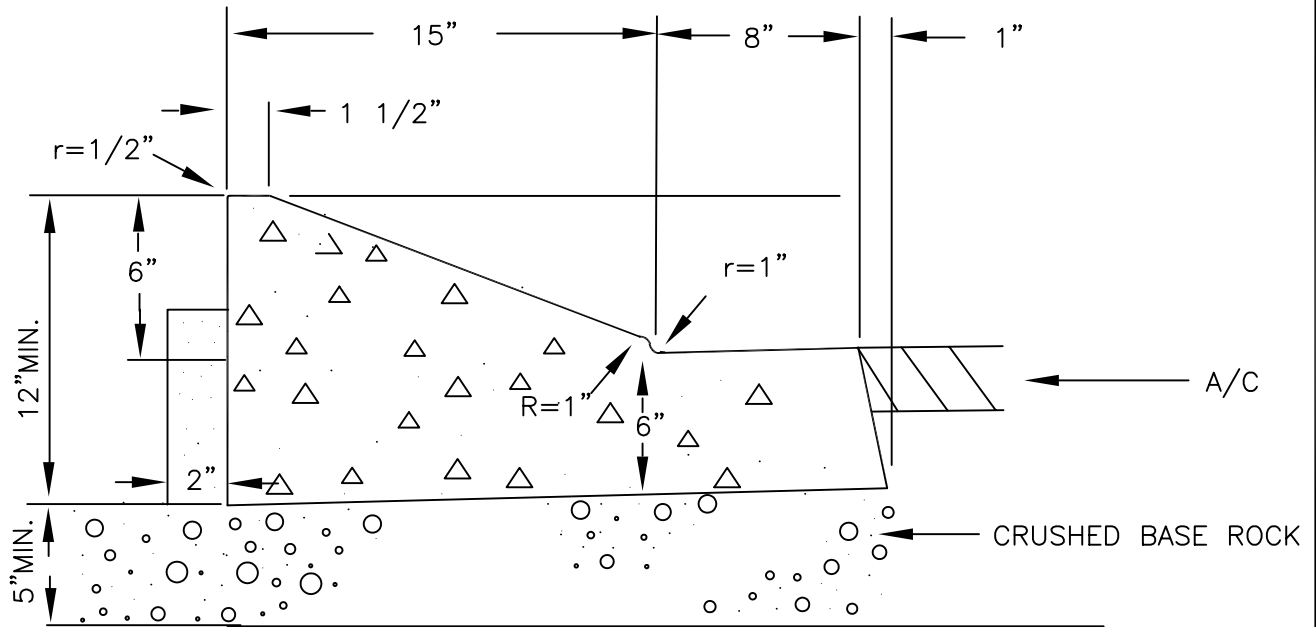


1. PCC SHALL BE 3300 PSI STRENGTH AT 28 DAYS. EXCEPT IN COMMERCIAL AREAS WHERE PCC SHALL BE 5,000 PSI STRENGTH AT 28 DAYS.
2. CONTRACTION JOINTS SHALL BE PLACED AT 15' MAX. SPACING.
3. CURB EXPOSURE SHALL BE 8.5" AT ALL CATCH INLETS.
4. DRAIN BLOCKOUTS SHALL BE PLACED 2 PER LOT 6" INSIDE EACH PROPERTY LINE. DRAIN PIPE SHALL BE EXTENDED TO 1' BEHIND BACK OF WALK WHERE SIDEWALK IS INSTALLED BEFORE THE LOT IS CONNECTED TO THE DRAIN PIPE.
5. ADD 2" WIDE AND 4" DEEP SHELF WHEN CURB IS PLACED ADJACENT TO SIDEWALK.
6. CRUSHED BASE ROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
7. TYPE "C" CURB SHALL ONLY BE INSTALLED AT LOCATIONS (REPLACEMENT) TO MATCH EXISTING CURB TYPE.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 TYPE "C" CURB	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 603


MOUNTABLE CURB

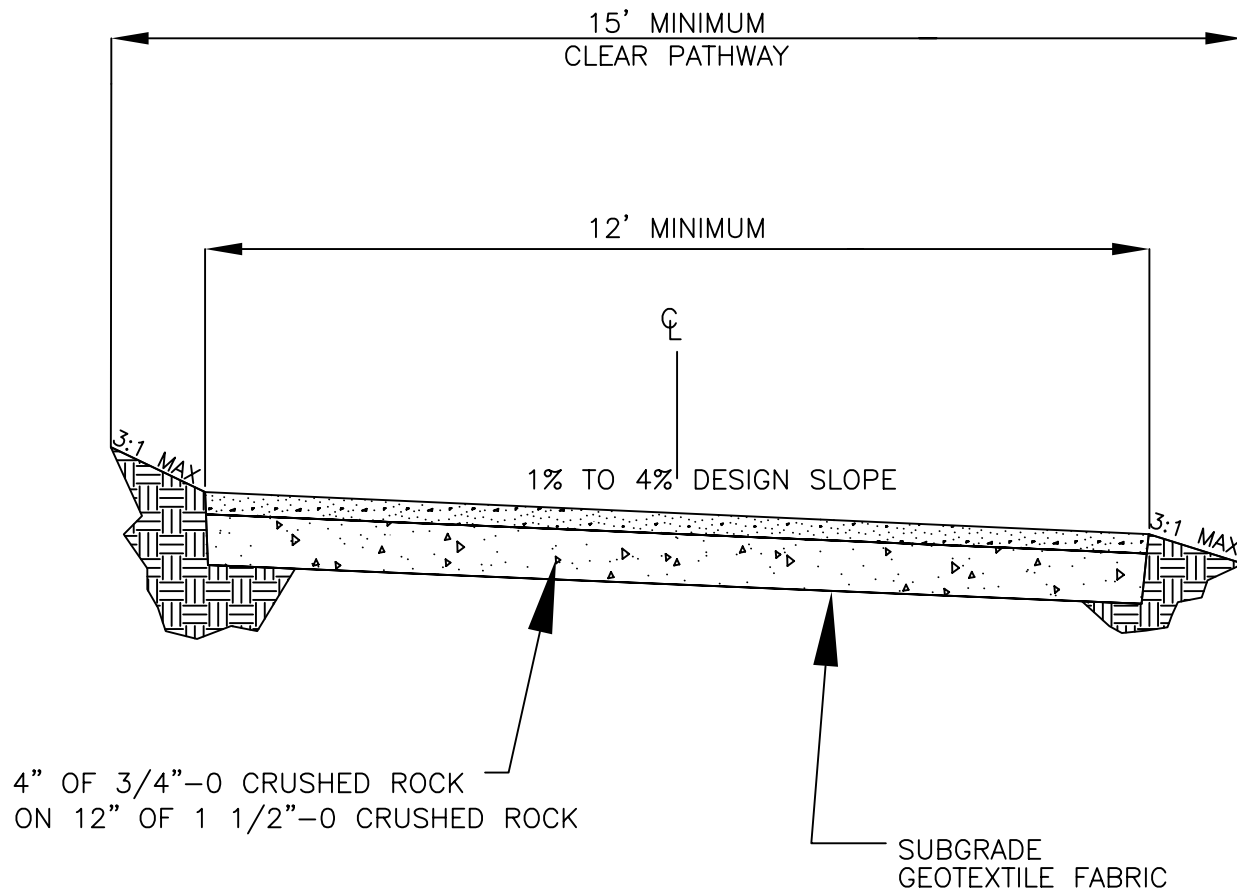
TO BE USED FOR HIGH DENSITY DEVELOPMENT
WITH MANAGER'S APPROVAL



TRANSITION DETAIL

1. PCC SHALL BE 3300 PSI STRENGTH AT 28 DAYS.
2. CONTRACTION JOINTS SHALL BE PLACED AT 15' MAX. SPACING.
3. ADD 2" WIDE 4" DEEP SHELF WHEN CURB IS PLACED ADJACENT TO SIDEWALK.
4. CRUSHED BASE ROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
5. ROOF DRAINS SHALL DRAIN DIRECTLY TO DRAINAGE CATCH BASINS.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.	MOUNTABLE CURB	APPR. 
				DWG. NO. 604



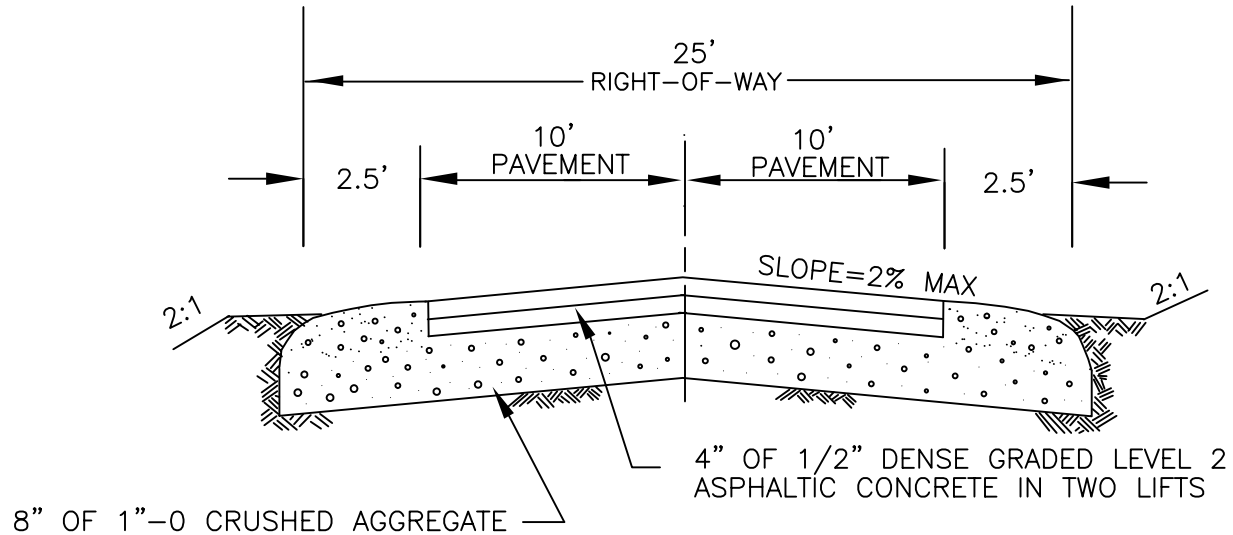
NOTES:

1. A BRANCH TURN-AROUND SHALL BE PROVIDED ON ALL DEAD-END ACCESS ROADS. THE BRANCH TURN-AROUND SHALL HAVE A MINIMUM TURNING RADIUS OF 50'.
2. SUBGRADE AND AGGREGATE SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. ACCESS ROAD GRADES ARE NOT TO EXCEED 10%.
4. BOLLARDS, PER DETAIL 631, ARE REQUIRED AT ALL ENTRANCES TO ACCESS ROADS.

DRAWN	DRB	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE	APPR.		APPR.	<i>DR</i>
			HEAVY VEHICLE PUBLIC FACILITY ACCESS ROAD	DWG. NO.	605

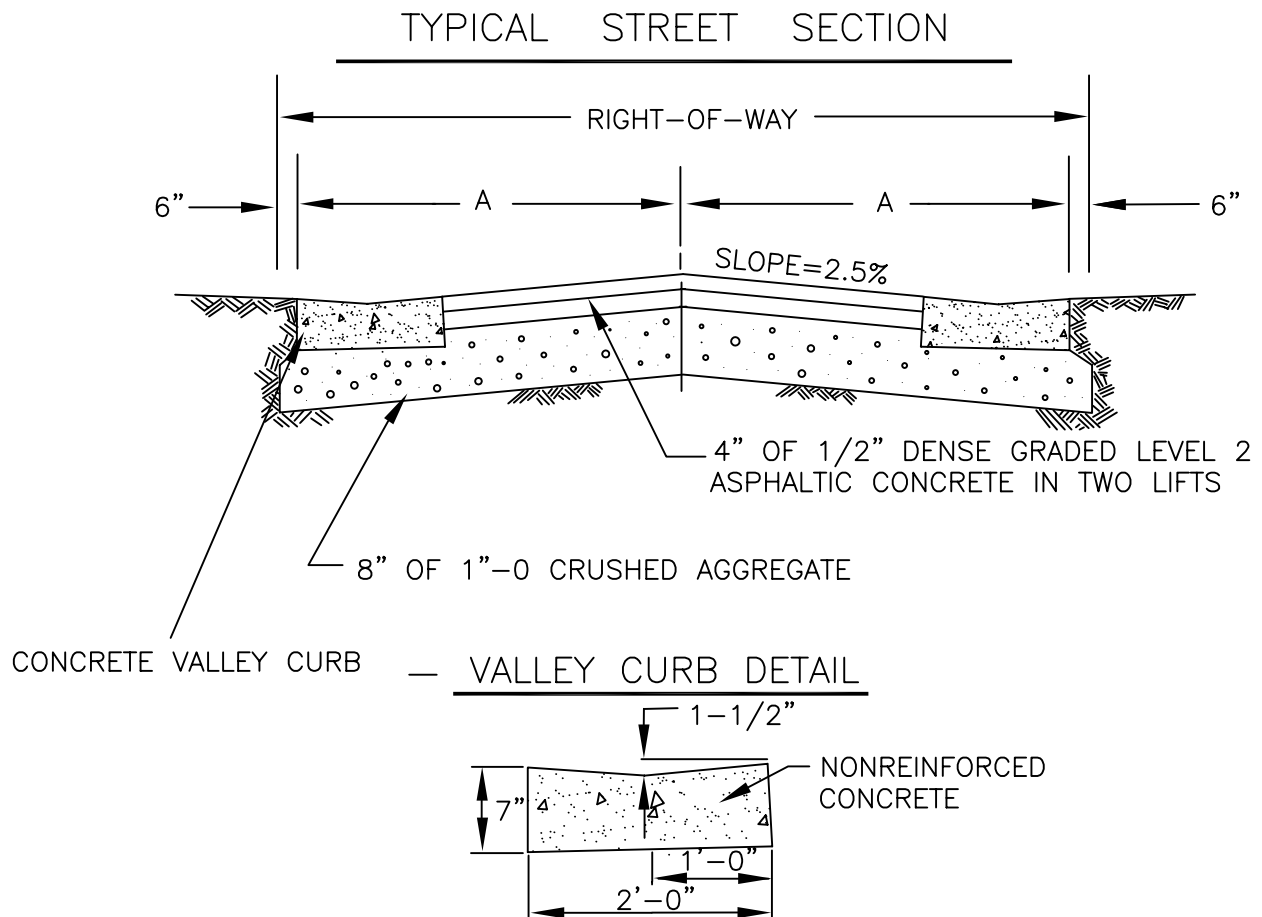
TYPICAL STREET SECTION

ACCESS TO PARKS AND OPEN SPACE



1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. VEHICLE CONTROL DEVICES MAY BE INSTALLED TO DETER INTRUSION INTO THE PARK. THESE INCLUDE BOLLARDS, BERMS, OR 6" EXTRUDED CURBS.
4. A SIDEWALK AND PLANTER STRIP ARE NOT REQUIRED.
5. ENGINEER OF RECORD IS RESPONSIBLE FOR PROVIDING ADEQUATE DRAINAGE/CONVEYANCE IN LIEU OF PROVIDING CURBS.

DRAWN DRB	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE N.T.S.
DIV. TRANSPORTATION			DATE JAN. 1, 2006
REV.	DATE	APPR.	APPR. <i>OR</i>
			DWG. NO. 606
STANDARD PUBLIC FACILITY ACCESS ROAD			



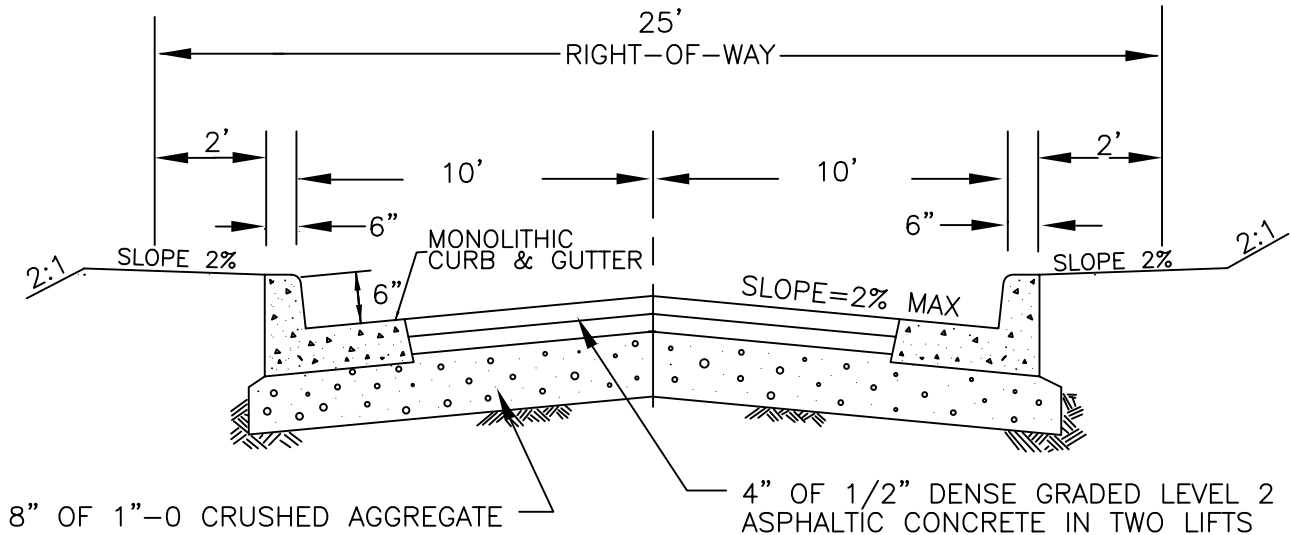
1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. PCC CURB SHALL BE 3300 PSI AT 28 DAYS.
4. "NO PARKING" SHALL BE POSTED THE ENTIRE LENGTH OF ALLEY IN RESIDENTIAL AND COMMERCIAL/INDUSTRIAL DISTRICTS.
5. FIRE HYDRANTS WHEN REQUIRED ARE TO BE LOCATED OUTSIDE THE R-O-W IN A 5' BY 5' EASEMENT.

STREET AND RIGHT-OF-WAY WIDTHS


FUNCTIONAL CLASSIFICATION	RIGHT-OF-WAY	"A" PAVEMENT WIDTH	SIDEWALK WIDTH	PLANTER STRIP WIDTH
ALLEY RESIDENTIAL DISTRICT	15'	7'	N/A	N/A
ALLEY-COMM. INDUSTRIAL DISTRICT	21'	10'	N/A	N/A

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE N.T.S.	
DIV. TRANSPORTATION					DATE JAN. 1, 2006	
REV.	DATE	APPR.			APPR. <i>[Signature]</i>	
			ALLEY STREET SECTION		DWG. NO. 607	

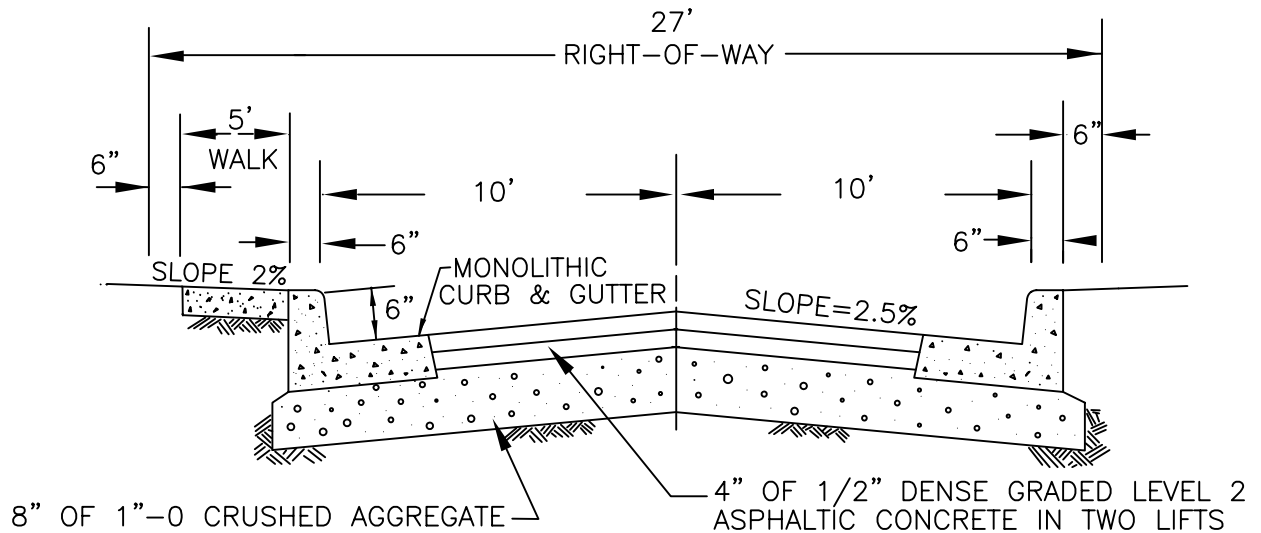
TYPICAL STREET SECTION




1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. PUBLIC PARKING FOR VISITORS (3-4 SPACES) AND A BRANCH TYPE TURNAROUND SHALL BE PROVIDED AT THE END OF THE MINOR ACCESS STREET. (SEE DETAIL # 621)
4. A "DEAD END" SIGN SHALL BE POSTED AT THE ENTRANCE TO THE MINOR ACCESS STREET.
5. "NO PARKING" SHALL BE POSTED FOR THE ENTIRE LENGTH OF THE MINOR ACCESS STREET.
6. THERE IS NO REQUIREMENT FOR A SIDEWALK OR PLANTER STRIP.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 MINOR ACCESS STREET	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 608

TYPICAL STREET SECTION

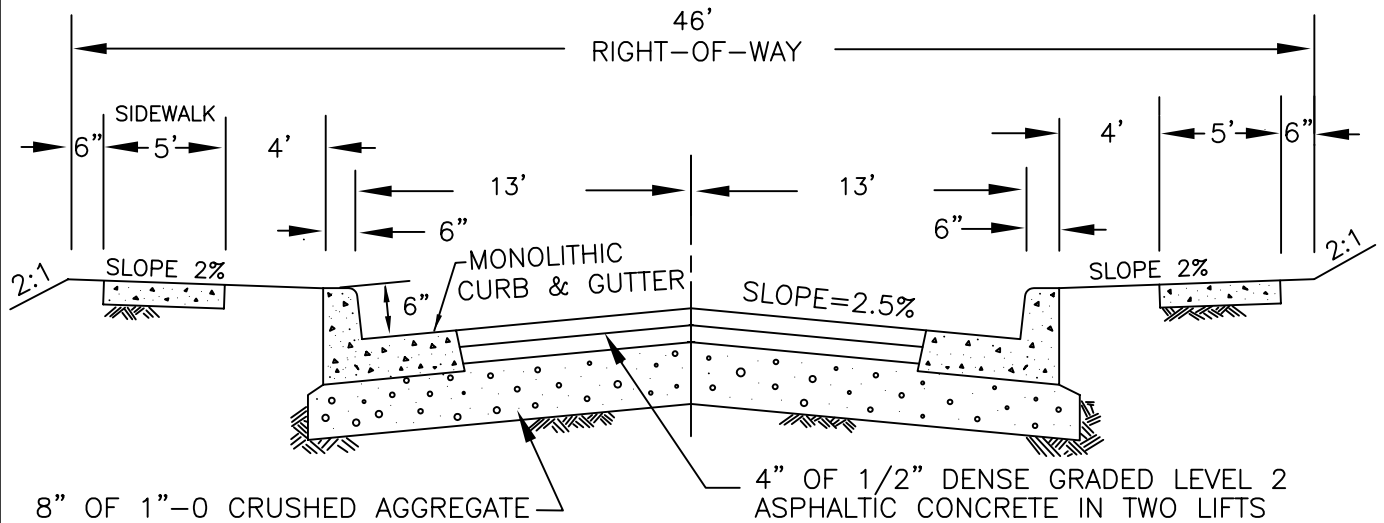


1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180
3. "NO PARKING" SHALL BE POSTED FOR THE ENTIRE LANE.
4. FIRE HYDRANTS, WHEN REQUIRED, ARE TO BE LOCATED OUTSIDE THE R-O-W IN A 5' BY 5' EASEMENT.
5. A PLANTER STRIP IS NOT REQUIRED.


DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 609
			LOCAL LANE STREET SECTION	

LOCAL LANE STREET SECTION

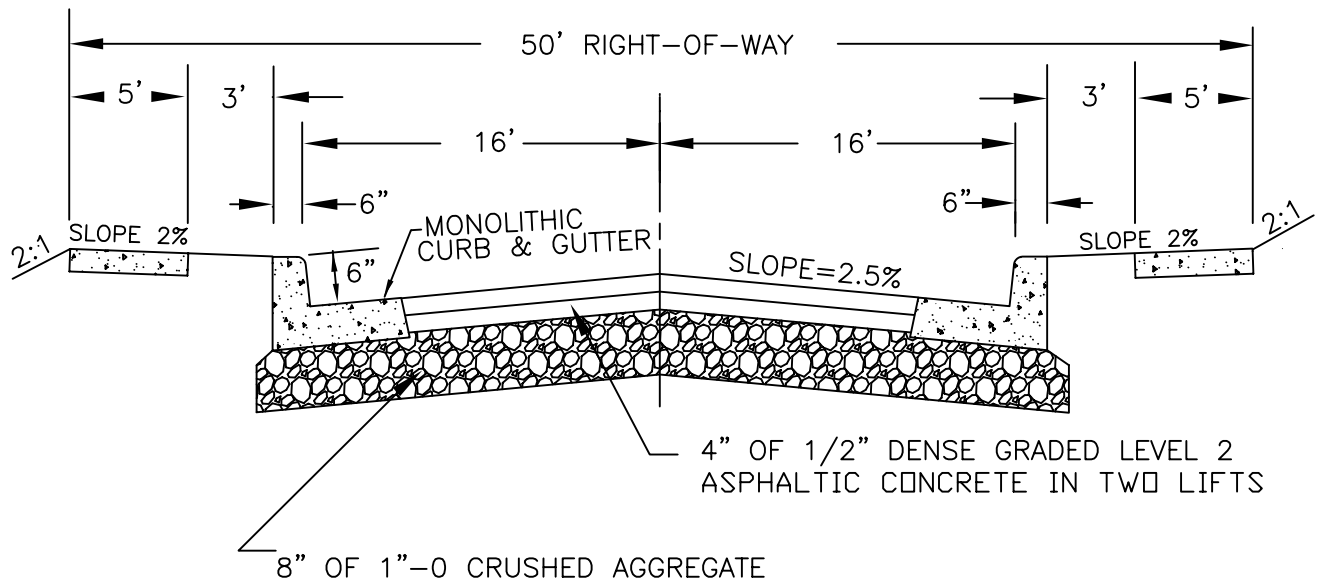
TYPICAL STREET SECTION




1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE SIDEWALK SHALL HAVE A 5' MINIMUM CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY THE CITY ENGINEER.
4. THE MAXIMUM BLOCK LENGTH FOR A QUEUING STREET IS 400 FT.
5. "NO PARKING" SHALL BE POSTED WITHIN 30 FT. OF CURB RETURN ON QUEUING STREET.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE AUGUST 2005
REV.	DATE	APPR.		APPR. 
				DWG. NO. 610
			LOCAL QUEUING STREET SECTION	

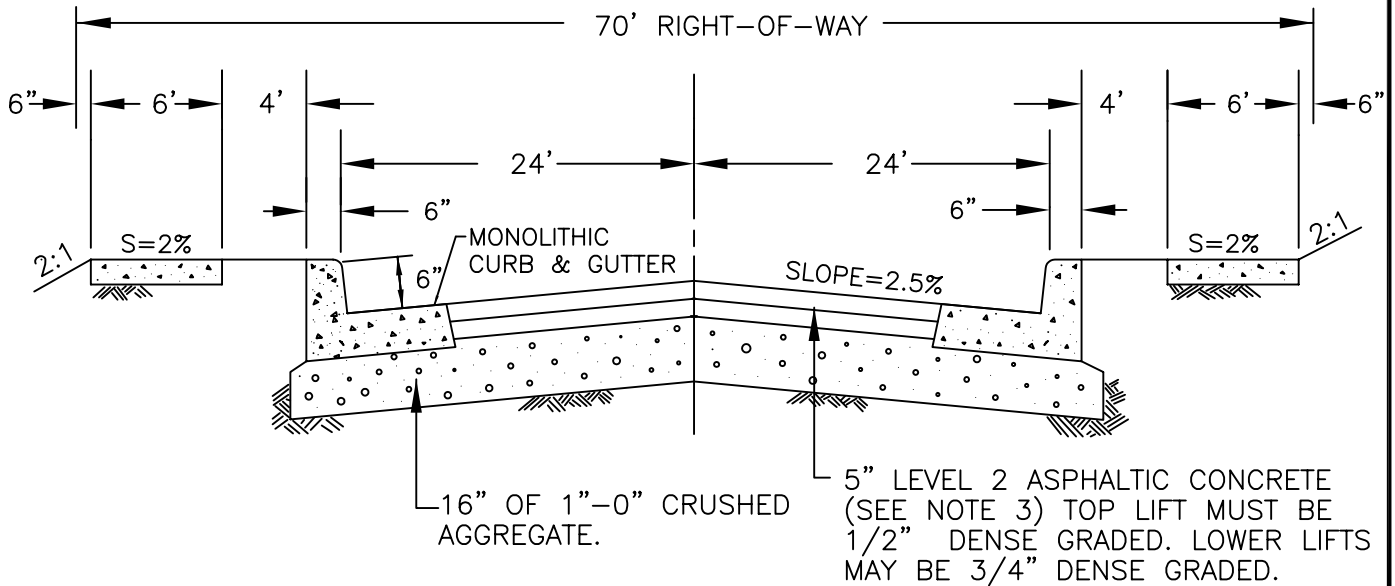
TYPICAL STREET SECTION




1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RELATIVE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY. PER AASHTO T-180
3. IN HILLSIDE CONSTRAINT DISTRICT RIGHT-OF-WAY WIDTH MAY BE 40' WITH A PAVEMENT WIDTH OF 28'.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' AREA CLEAR OF ALL OBSTACLES UNLESS APPROVED BY THE ENGINEER.
5. LOCAL STREETS PROJECTED TO HAVE AN AVERAGE DAILY TRAFFIC (ADT) OVER 1000 VEHICLES PER DAY SHALL BE CONSTRUCTED TO A COMMUNITY STREET.
6. FIRE HYDRANTS BEHIND THE WALK ON HILLSIDE CONSTRAINT DISTRICT AND COMMERCIAL/INDUSTRIAL DISTRICTS REQUIRE A 5' BY 5' EASEMENT.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
			LOCAL TRANSITIONAL STREET SECTION	DWG. NO. 611

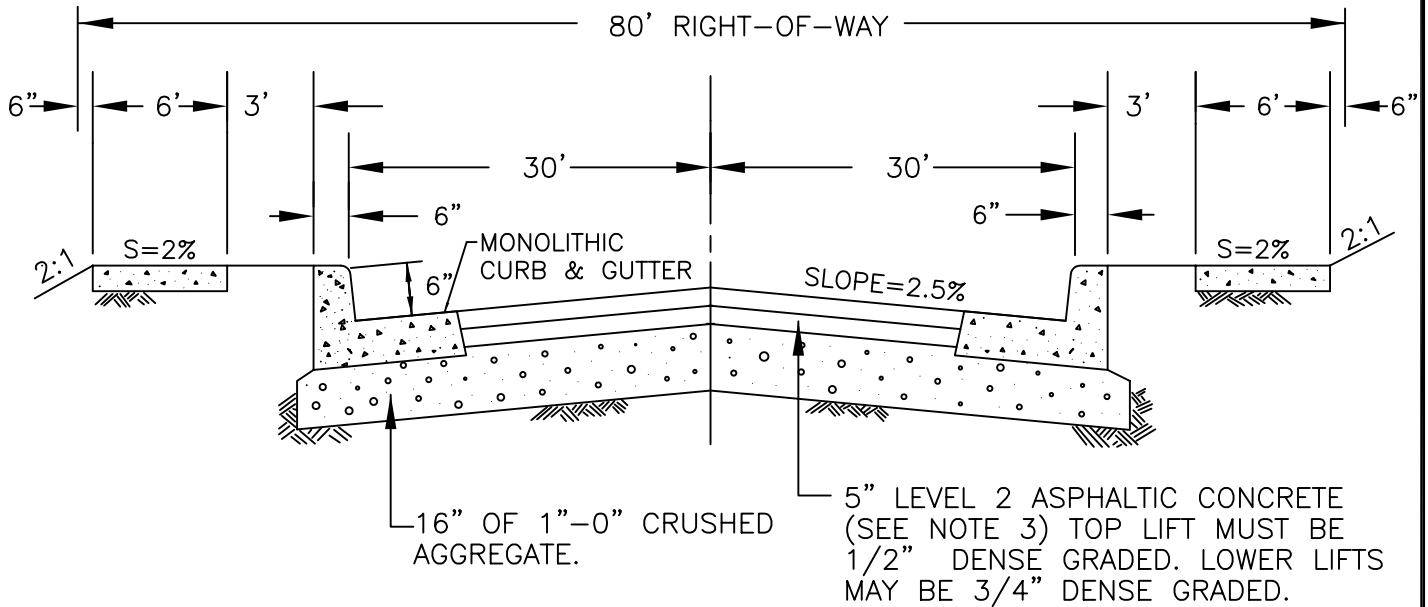
TYPICAL STREET SECTION




1. ASPHALT CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES UNLESS APPROVED BY THE CITY ENGINEER.

DRAWN			AJB	<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>COMMUNITY STREET SECTION</div>	SCALE	N.T.S.
DIV.			TRANSPORTATION		DATE	JAN. 1, 2006
REV.	DATE	APPR.			APPR.	
					DWG. NO.	612

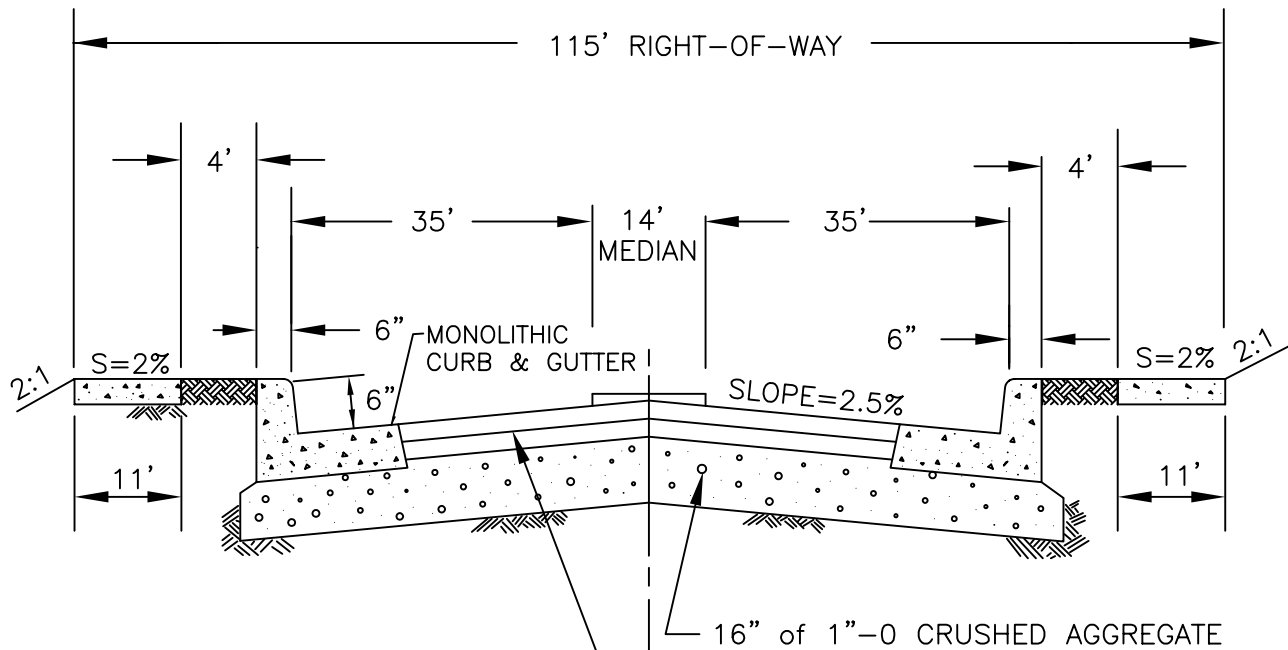
TYPICAL STREET SECTION



1. ASPHALT CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED T 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES UNLESS APPROVED BY THE CITY ENGINEER.
5. A 12' RAISED MEDIAN OR TWO-WAY LEFT TURN LANE SHALL SEPARATE THROUGH LANES.


DRAWN			AJB			DEPARTMENT OF ENVIRONMENTAL SERVICES			SCALE			N.T.S.		
DIV.			TRANSPORTATION						DATE			JAN. 1, 2006		
REV.	DATE	APPR.	CITY OF GRESHAM						APPR.					
									1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030			DWG. NO.		
COLLECTOR STREET SECTION														

TYPICAL STREET SECTION

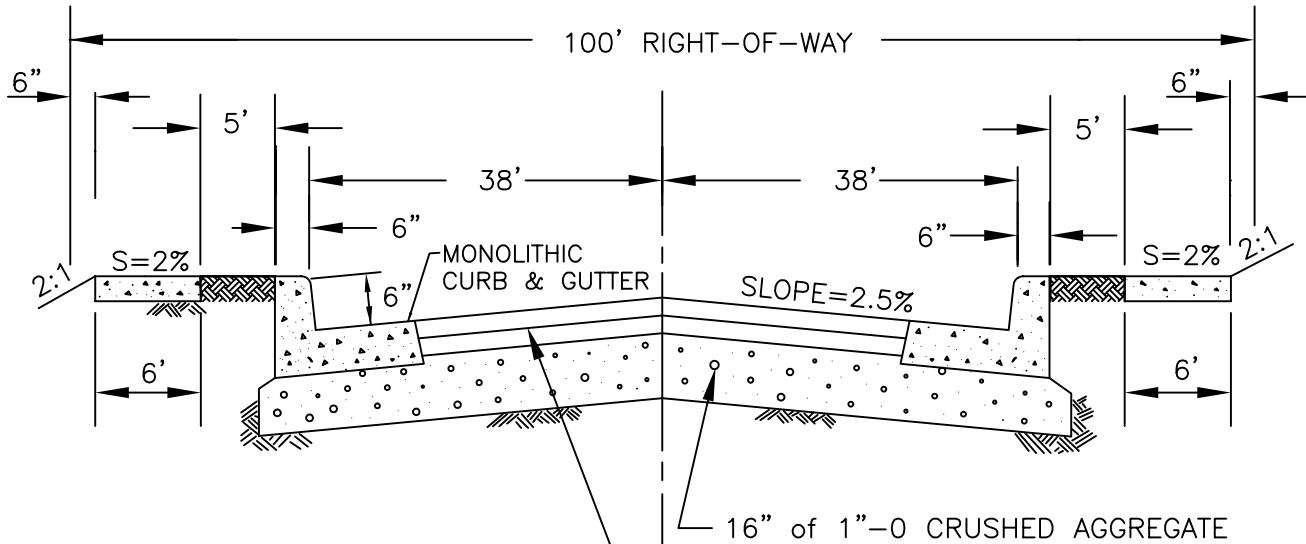


8" LEVEL 2 ASPHALTIC CONCRETE
(SEE NOTE 3) TOP LIFT MUST BE
1/2" DENSE GRADED. LOWER LIFTS
MAY BE 1/2" OR 3/4" DENSE GRADED.

1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY CITY ENGINEER.

DRAWN AJB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 614
			BOULEVARD	

TYPICAL STREET SECTION

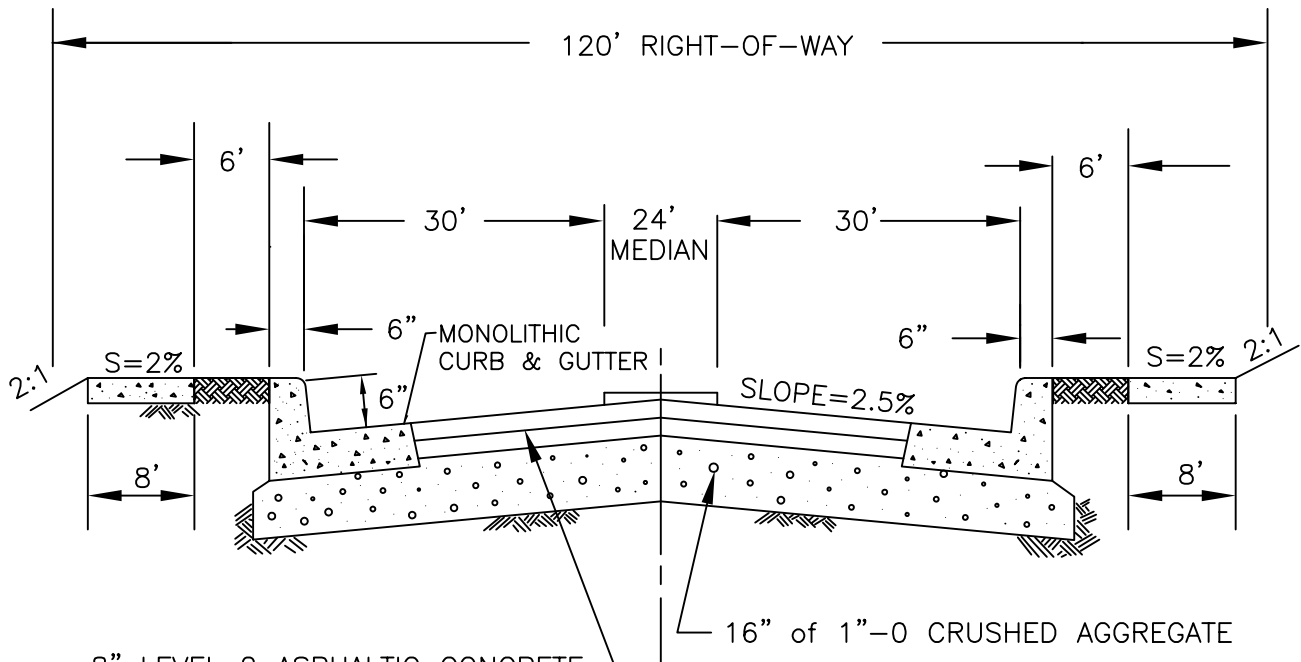


8" LEVEL 2 ASPHALTIC CONCRETE
(SEE NOTE 3) TOP LIFT MUST BE
1/2" DENSE GRADED. LOWER LIFTS
MAY BE 1/2" OR 3/4" DENSE GRADED.

1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY CITY ENGINEER.
5. A 16' RAISED MEDIAN OR TWO-WAY-LEFT LANE SHALL SEPARATE OPPOSING TRAVEL LANES.

DRAWN AJB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 ARTERIAL STREET SECTION	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 615

TYPICAL STREET SECTION



8" LEVEL 2 ASPHALTIC CONCRETE
(SEE NOTE 3) TOP LIFT MUST BE
1/2" DENSE GRADED. LOWER LIFTS
MAY BE 1/2" OR 3/4" DENSE GRADED.

1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY CITY ENGINEER.

DRAWN AJB

DIV. TRANSPORTATION

REV. DATE APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

PRINCIPAL ARTERIAL

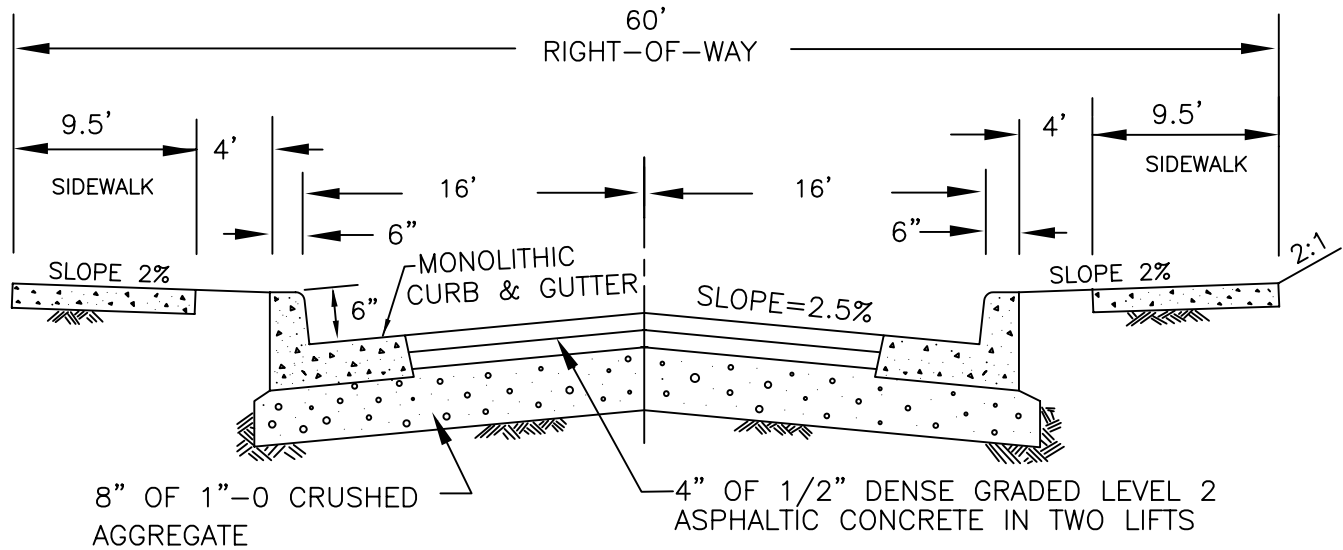
SCALE N.T.S.

DATE JAN. 1, 2006

APPR. *OR*

DWG. NO. 616

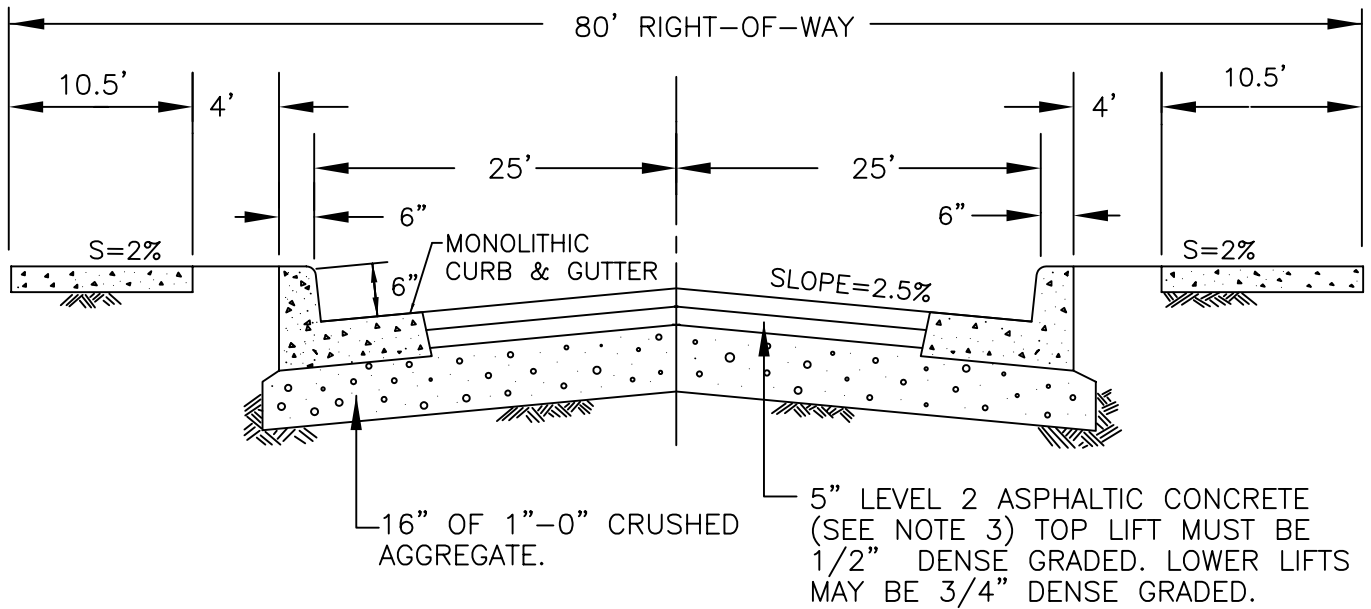
TYPICAL STREET SECTION



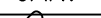
1. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE SIDEWALK SHALL HAVE A 5' MINIMUM CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY THE CITY ENGINEER.
4. THE MAXIMUM BLOCK LENGTH FOR A QUEUING STREET IS 400 FT.
5. "NO PARKING" SHALL BE POSTED WITHIN 30 FT. OF CURB RETURN ON QUEUING STREET.

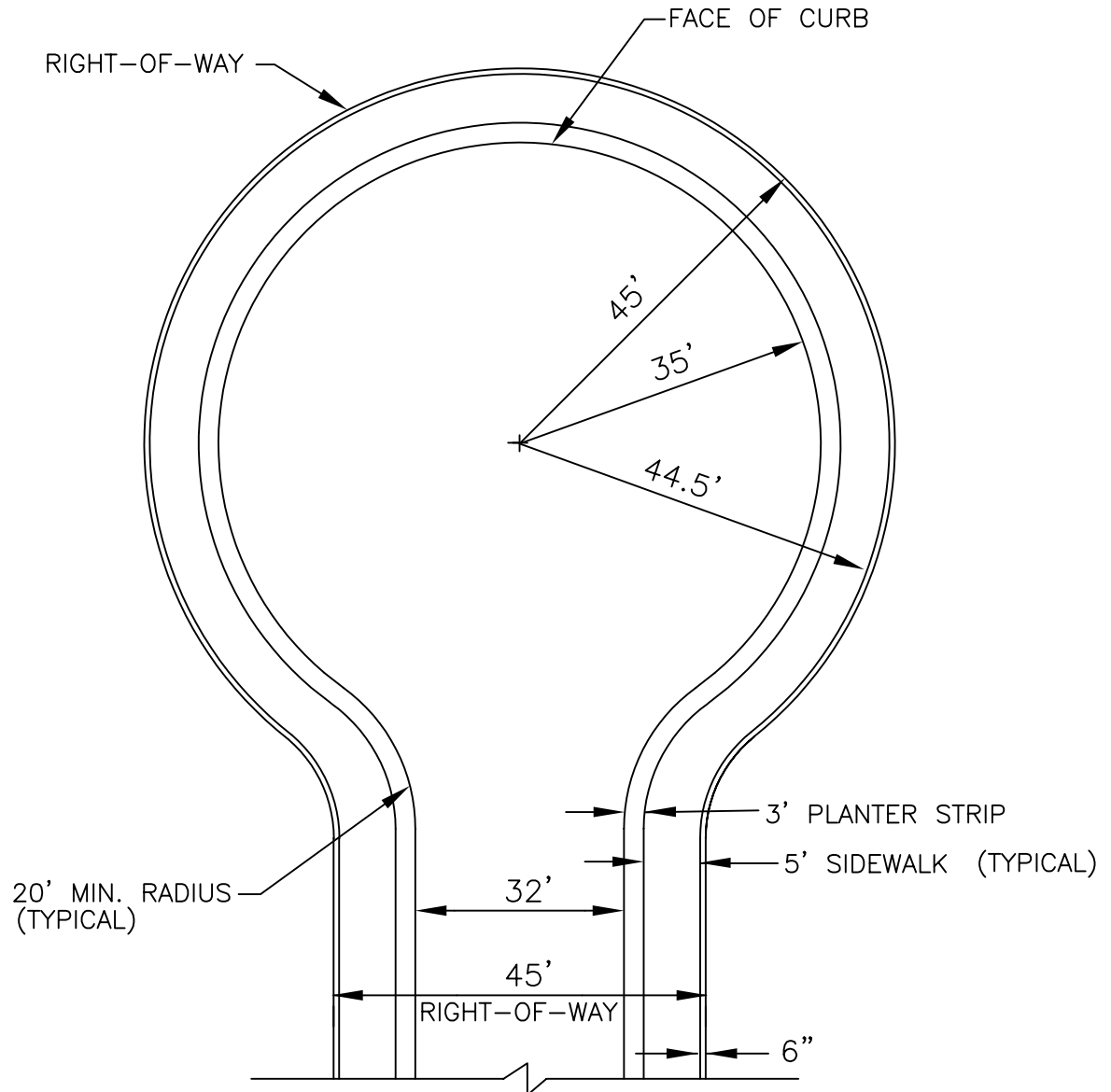
DRAWN AJB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 CIVIC NEIGHBORHOOD LOCAL STREET	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 617

TYPICAL STREET SECTION




1. ASPHALT CONCRETE SHALL BE COMPACTED TO 91% OF RICE DENSITY.
2. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
3. THE ENGINEER MAY REQUIRE LEVEL 3 ASPHALTIC CONCRETE.
4. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES UNLESS APPROVED BY THE CITY ENGINEER.

DRAWN			AJB	<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>CIVIC NEIGHBORHOOD</div> <div>COLLECTOR STREET</div>	SCALE	N.T.S.
DIV. TRANSPORTATION					DATE	JAN. 1, 2006
REV.	DATE	APPR.			APPR.	
					DWG. NO.	618

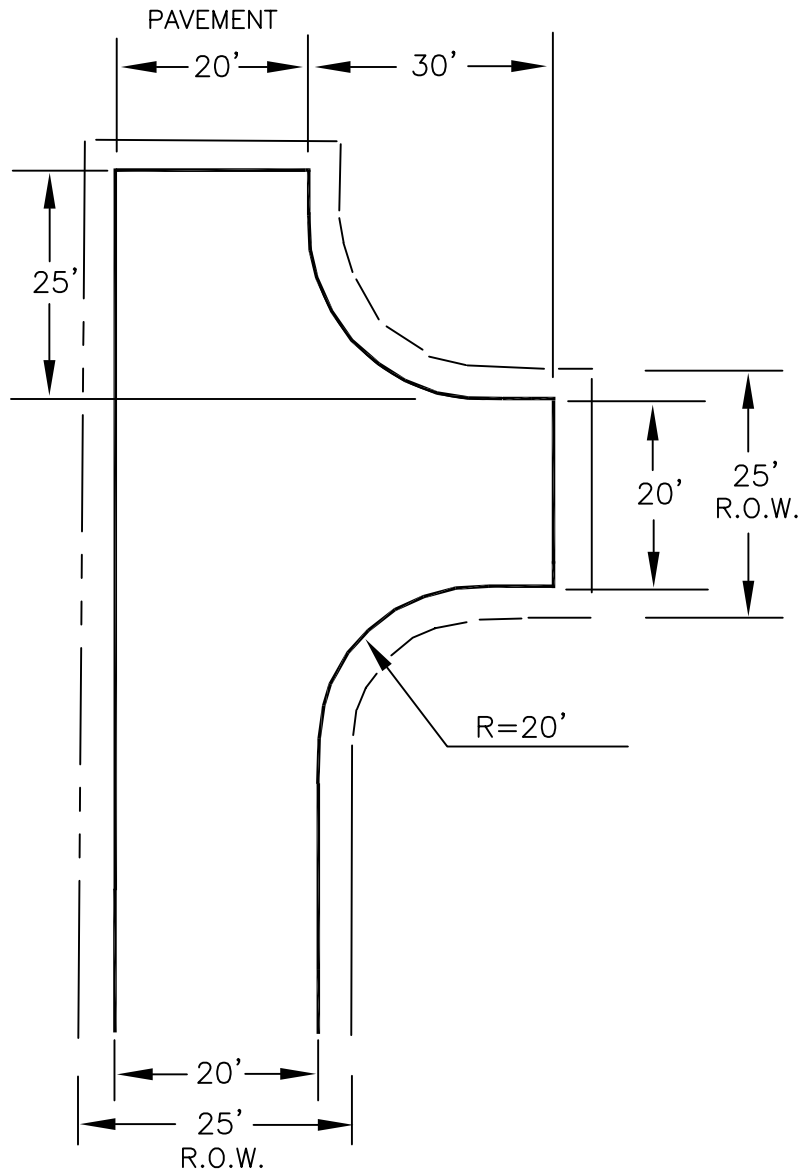


PAVEMENT WIDTH EXCEPTIONS:

1. A 28' WIDTH MAY BE ALLOWED WITHIN THE HILLSIDE CONSTRAINT DISTRICTS WITH ENGINEER'S APPROVAL.
2. THE SIDEWALK IS TO BE LOCATED NEXT TO THE CURB ON THE ENTIRE LENGTH OF THE CUL-DE-SAC IN HILLSIDE CONSTRAINT DISTRICTS.
3. THE SIDEWALK SHALL HAVE A MINIMUM 5' CLEAR OF ALL OBSTACLES, UNLESS APPROVED BY THE CITY ENGINEER.
4. NO FIRE HYDRANTS ARE TO BE LOCATED IN THE CUL-DE-SAC AREA.

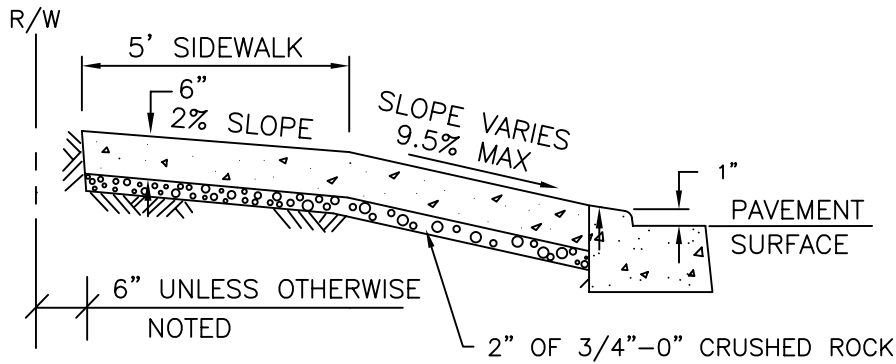
DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD CUL-DE-SAC	SCALE N.T.S.
ENGR. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 619

STANDARD CUL-DE-SAC

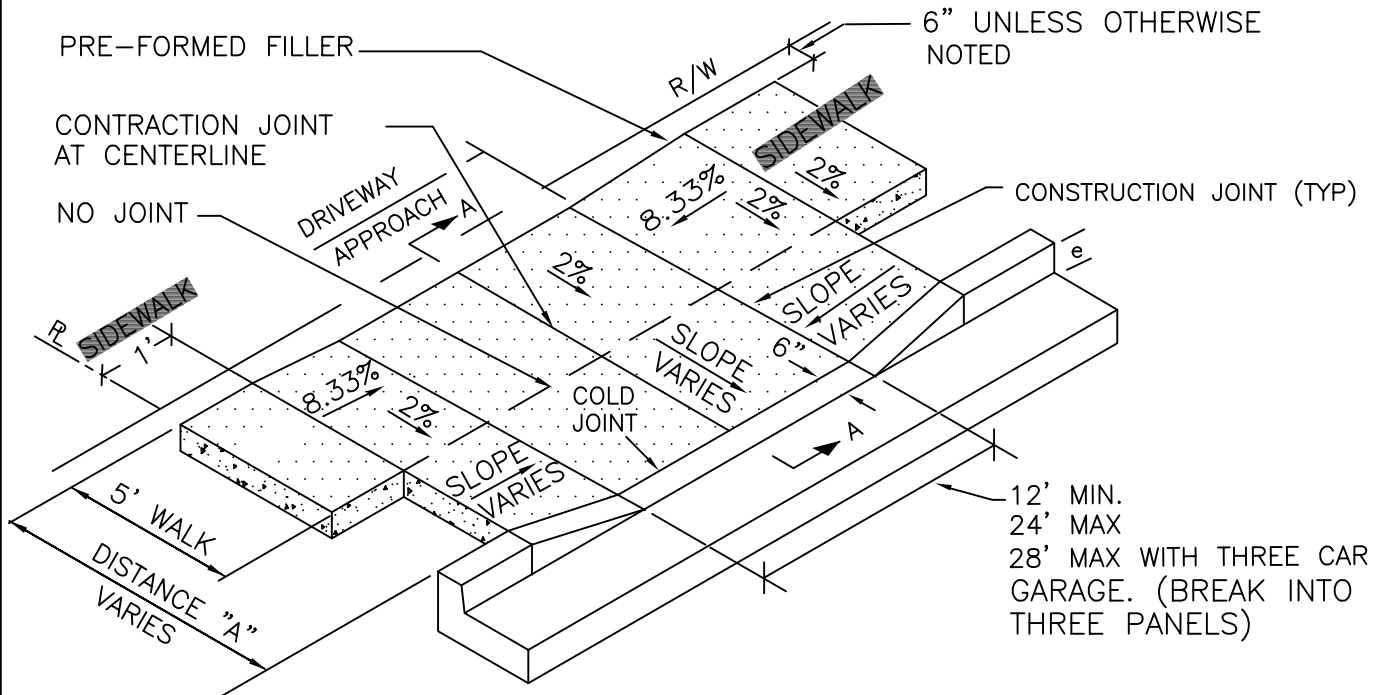


1. BRANCH TURNAROUND TO BE USED AT THE END OF A MINOR ACCESS STREET.
2. A "DEAD-END" SIGN SHALL BE POSTED AT ENTRANCE TO THE MINOR ACCESS STREET.
3. "NO PARKING" SHALL BE POSTED FOR THE ENTIRE MINOR ACCESS STREET.
4. THE MAXIMUM LENGTH OF THE MINOR ACCESS STREET SHALL BE 150 FT. TO THE END OF THE TURNAROUND.
5. NO FIRE HYDRANTS ARE TO BE LOCATED ON A MINOR ACCESS STREET WITH A BRANCH TURNAROUND.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.	APPR. <i>[Signature]</i> DWG. NO. 620	
BRANCH TURNAROUND				

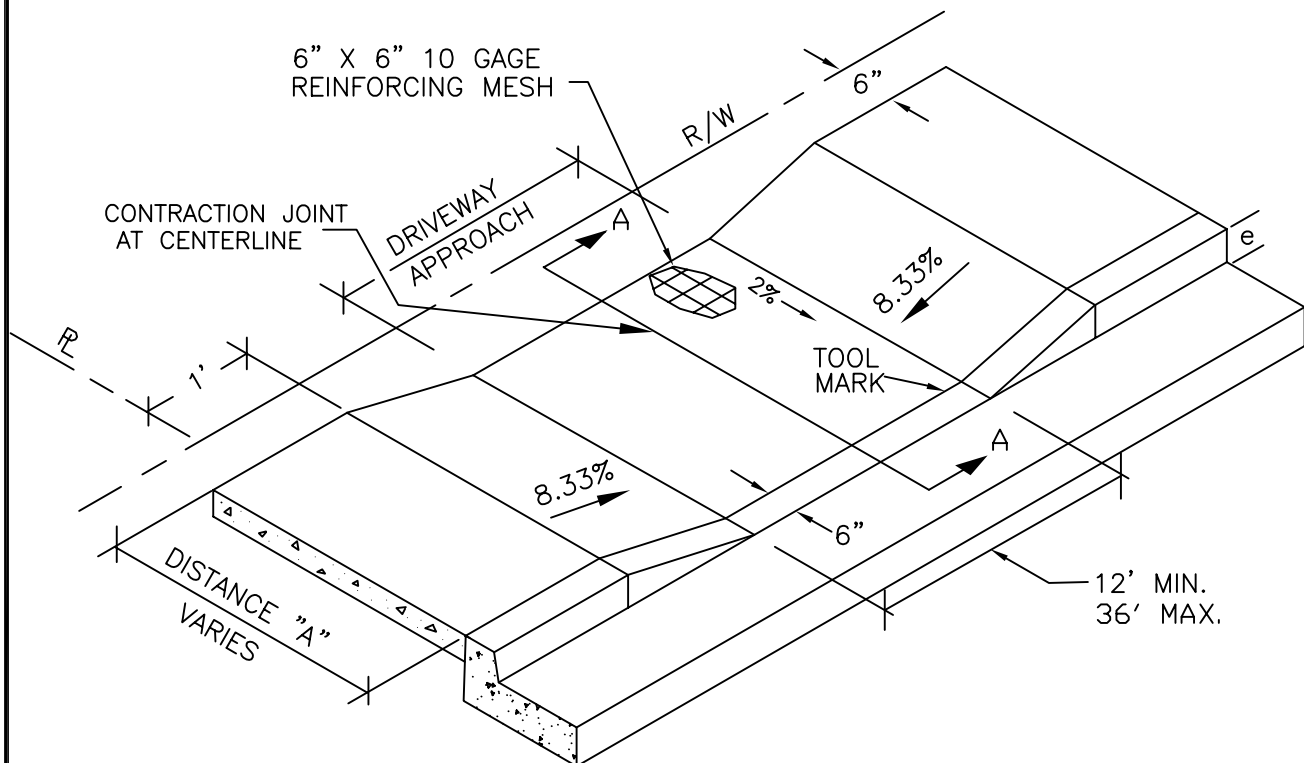
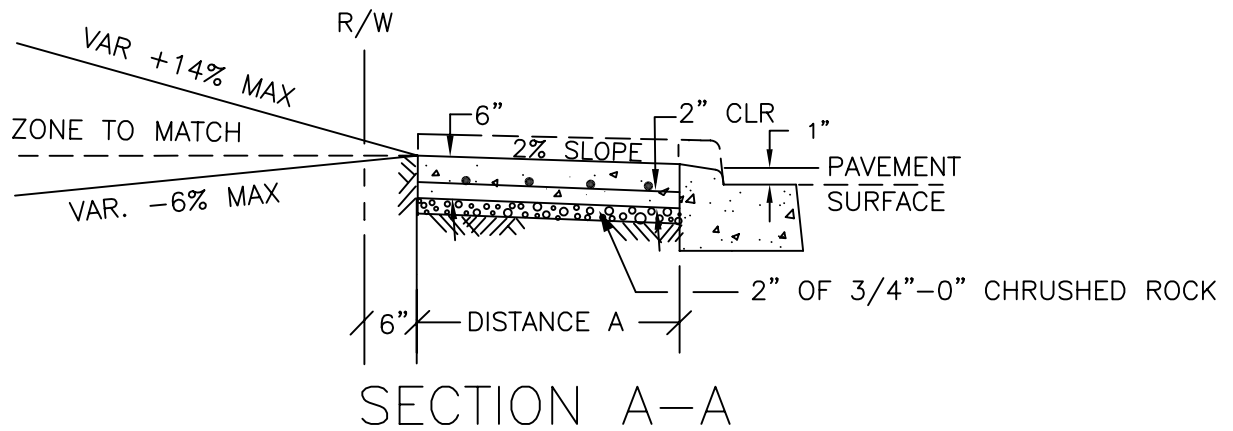


SECTION A - A




1. DISTANCE "A" VARIES WITH STREET FUNCTIONAL CLASSIFICATION. SLOPE WILL VARY WITH DISTANCE "A".
2. SEE STANDARD DETAILS 602 AND 603 FOR CURB EXPOSURE DIMENSION 'e'.
3. SLOPES SHOWN ARE RELATIVE TO HORIZONTAL. TRANSITION RAMP (8.33% MAX SLOPE) SHALL NOT EXCEED MAXIMUM LENGTH OF 8'. SIDE FLARES IN PLANTER STRIP MAY BE ANY SLOPE.
4. DO NOT SLOPE LANDING MORE THAN 2% IN ANY DIRECTION.
5. CONCRETE SHALL BE 3,300 PSI AT 28 DAYS.

DRAWN DRB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 RESIDENTIAL DRIVEWAY APPROACH	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 621

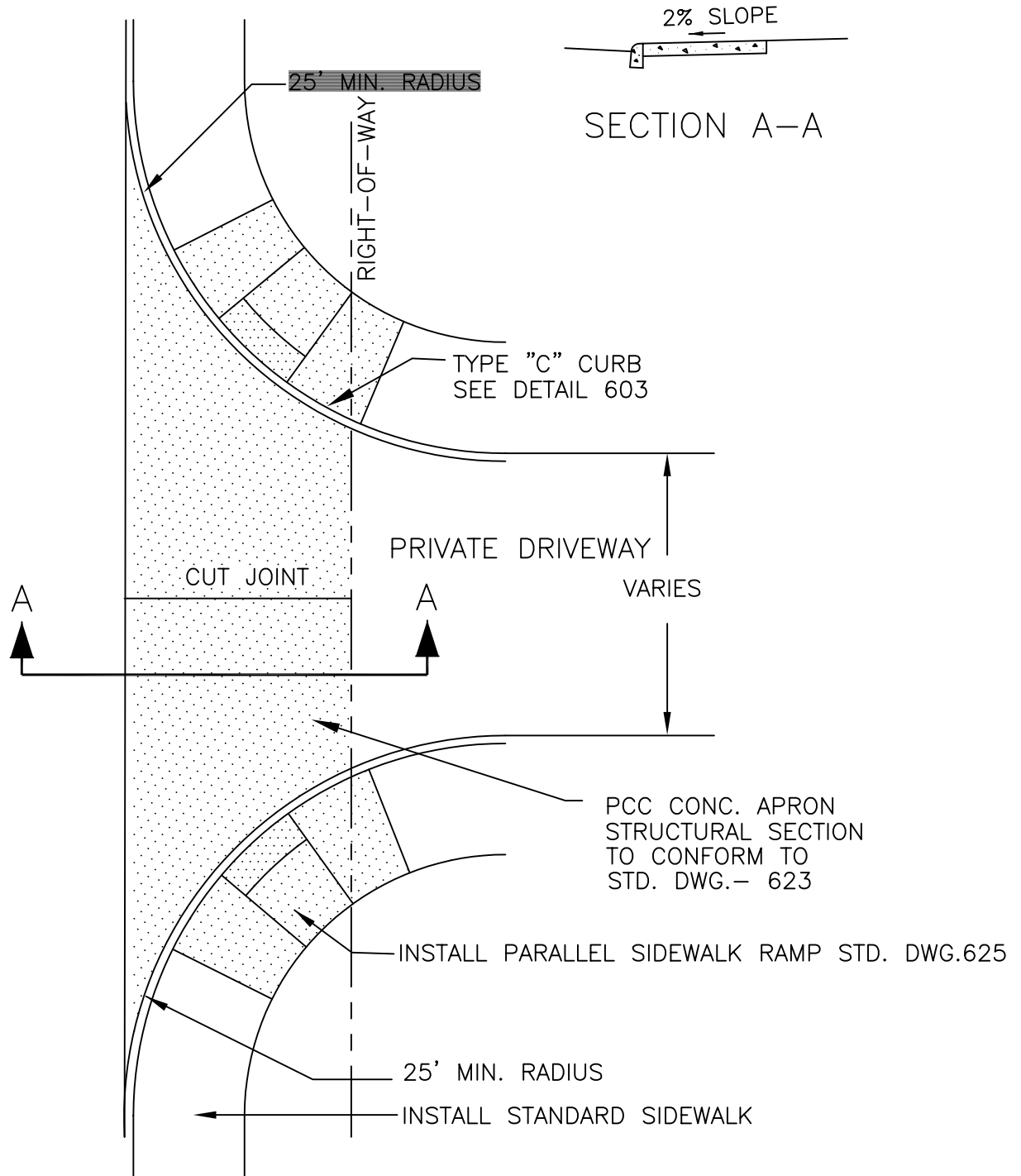


1. DISTANCE "A" VARIES WITH STREET FUNCTIONAL CLASSIFICATION.
2. SEE STANDARD DETAILS 602 AND 603 FOR CURB EXPOSURE DIMENSION 'e'.
3. SLOPES SHOWN ARE RELATIVE TO HORIZONTAL. TRANSITION RAMP (8.33% MAX. SLOPE) SHALL NOT EXCEED MAXIMUM LENGTH OF 8'.
4. CONCRETE SHALL BE 5,000 PSI AT 28 DAYS.


DRAWN			DRB	<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>COMMERCIAL DRIVEWAY APPROACH</div>	SCALE	N.T.S.
DIV.			TRANSPORTATION		DATE	JAN. 1, 2006
REV.	DATE	APPR.			APPR.	
					DWG. NO.	622

COMMERCIAL DRIVEWAY APPROACH

PUBLIC ROAD

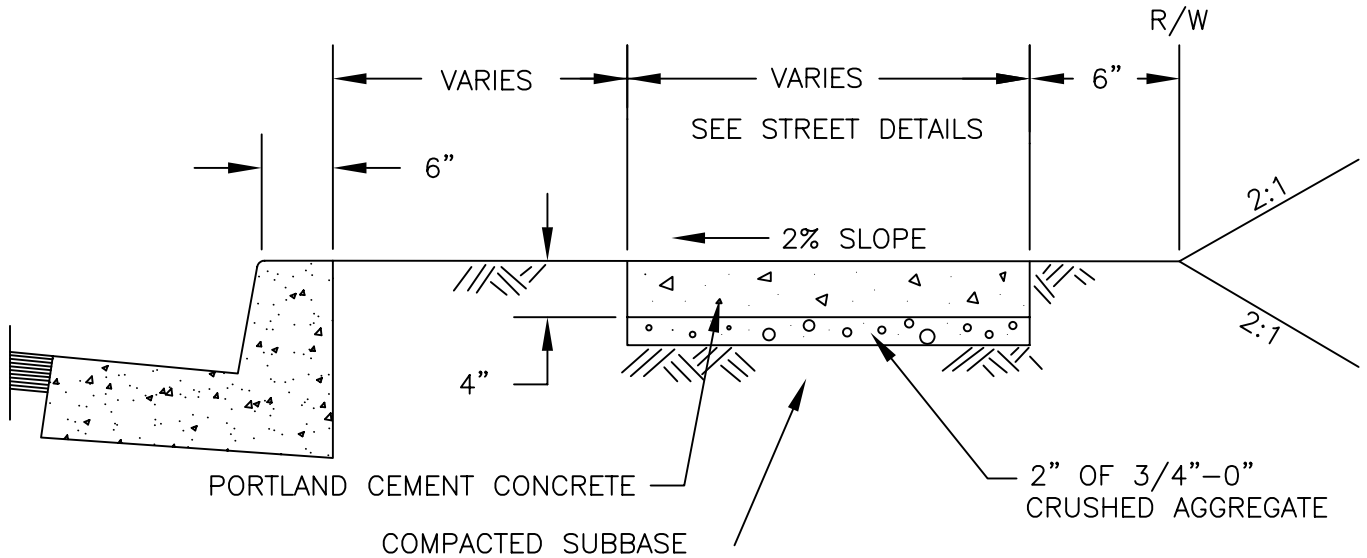


THIS TYPE OF APPROACH TO BE USED FOR HIGH VOLUME
TRAFFIC GENERATORS (500 ADT OR GREATER) WITH APPROVAL
OF ENGINEER.

DRAWN TA			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 CURB RETURN DRIVEWAY APPROACH	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 623

TYPICAL SIDEWALK DETAIL

(FOR LOCAL STREET)

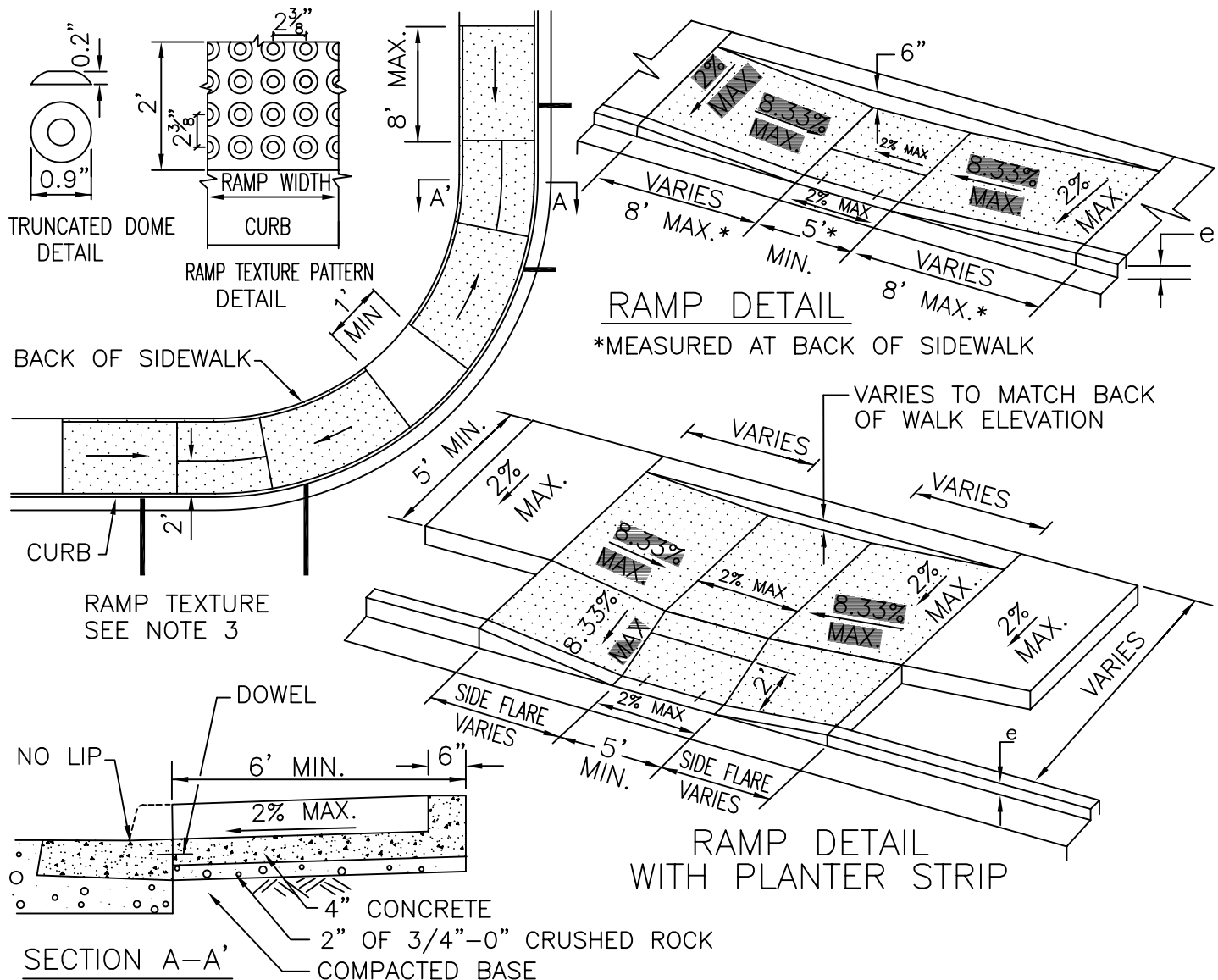


1. LOCATION AND WIDTH OF SIDEWALK WILL VARY DEPENDING UPON FUNCTIONAL CLASSIFICATION OF THE STREET. SEE TYPICAL STREET SECTION STANDARD DETAILS.
2. PCC SHALL BE 3300 PSI STRENGTH AT 28 DAYS.
3. EXPANSION JOINTS SHALL BE PLACED IN SIDEWALK WHEN CURB AND SIDEWALK ARE ADJACENT AND THERE IS AN EXPANSION JOINT IN THE CURB.
4. CONTRACTION JOINTS SHALL BE PLACED AT ALL CHANGES OF DIRECTION, POINTS OF CURVATURE, ALIGNED WITH CURB CONTRACTION JOINTS WHEN SIDEWALK IS ADJACENT TO CURB, AND AT 15' (MAX) INTERVALS. JOINTS SHALL BE 1/8" TO 1/4" WIDE AND A MINIMUM DEPTH OF 1/3 THE THICKNESS OF THE CONCRETE.
5. ALL SURFACES SHALL BE TROWELED AND BROOMED IN A WORKMANLIKE MANNER. ALL CONTRACTION JOINTS SHALL BE STEEL TROWELED (3 IN. TYP.).

DRAWN TA		
DIV. TRANSPORTATION		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES	
CITY OF GRESHAM	
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	
TYPICAL SIDEWALK DETAIL	

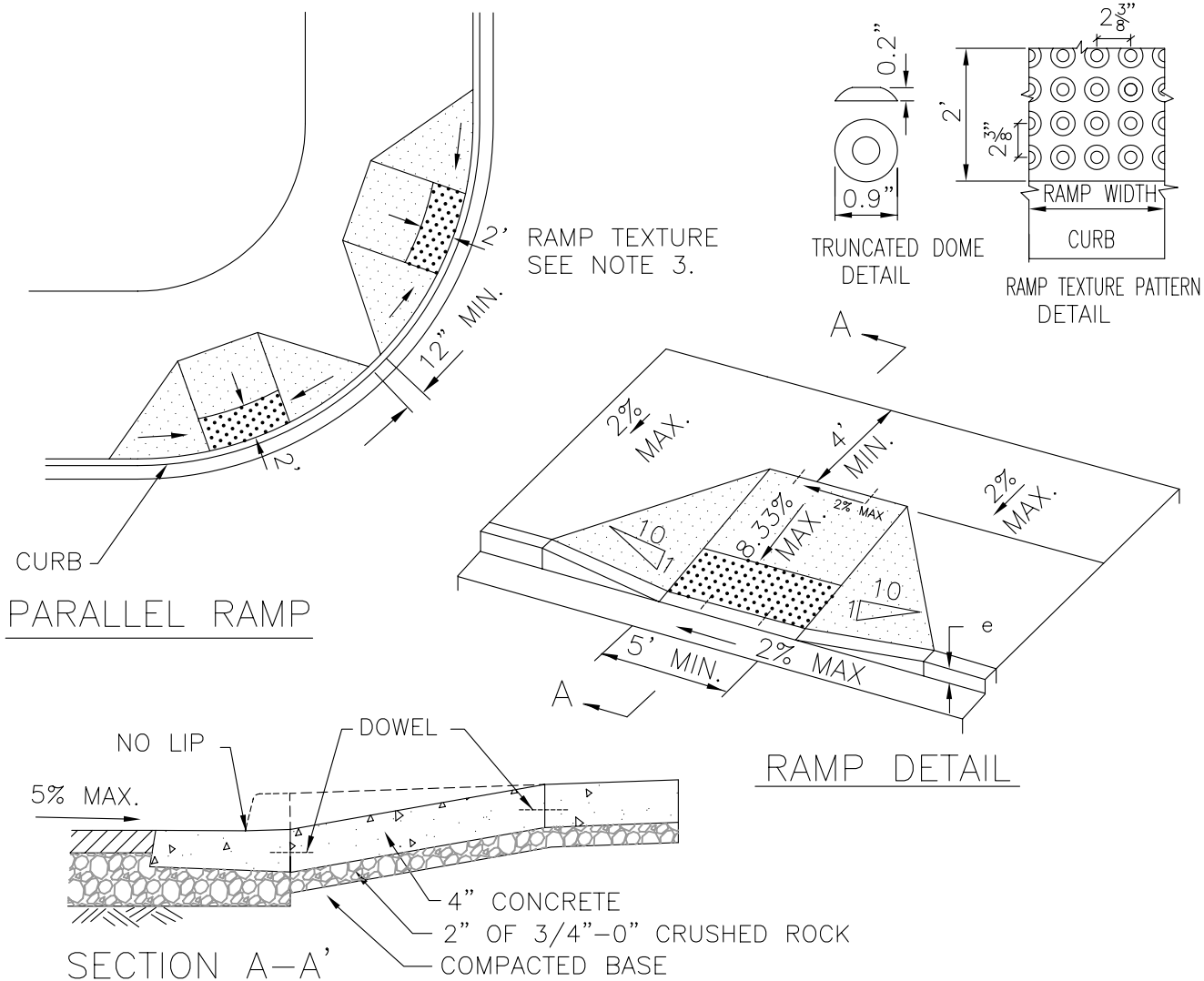
SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>OR</i>
DWG. NO.	624



1. TWO SIDEWALK RAMPS PER CORNER ARE REQUIRED AT ALL NEW INTERSECTIONS. RAMPS SHALL BE LOCATED WITHIN THE CROSSWALK AND AS NEAR THE CONTINUOUS PEDESTRIAN ROUTE AS PRACTICAL.
2. A SINGLE DIAGONAL RAMP MAY BE USED ONLY WHEN SITE CONSTRAINTS PROHIBIT INSTALLING TWO RAMPS AND APPROVED BY CITY ENGINEER.
3. PLACE TRUNCATED DOME DETECTABLE WARNING TEXTURE IN THE LOWER 2' OF THROAT OF RAMP ONLY. ARRANGE DOMES USING IN-LINE-PATTERN ONLY AS SHOWN IN DETAIL. COLOR OF TEXTURE TO BE BRICK RED.
4. SEE STANDARD DRAWING NUMBERS 602 AND 603 FOR CURB EXPOSURE DIMENSION "e". MATCH EXISTING "e" FOR RETROFIT APPLICATIONS.
5. SLOPES SHOWN ARE RELATIVE TO HORIZONTAL. SIDE FLARES IN PLANTER STRIP MAY BE OF ANY SLOPE.
6. SIDEWALK RAMPS SHALL BE FORMED AND POURED SEPARATE FROM SIDEWALK AND LANDINGS. COLD JOINTS SHALL BE KEYED OR DOWELED. EDGES OF THE ACCESSIBLE ROUTE SHALL BE POURED AGAINST RIGID FORMS OR CURED CONCRETE TO ENSURE COMPLIANCE WITH ORS 447.310 AND AMERICANS WITH DISABILITIES ACT.
7. DO NOT SLOPE LANDING MORE THAN 2% IN ANY DIRECTION. ADA RAMP CROSS-SLOPE SHALL NOT EXCEED 2% IN NEW CONSTRUCTION.
8. IN ALTERATIONS CURB RAMP SLOPE(S) MAY BE 10% FOR A MAX. RISE OF 6" OR 12.5% FOR MAX. RISE OF 3". CURB RAMP IN ALTERATIONS NEED NOT EXCEED 6' IN LENGTH. ADA RAMP CROSS-SLOPE MAYBE WARPED TO MATCH EXISTING GUTTER GRADE.

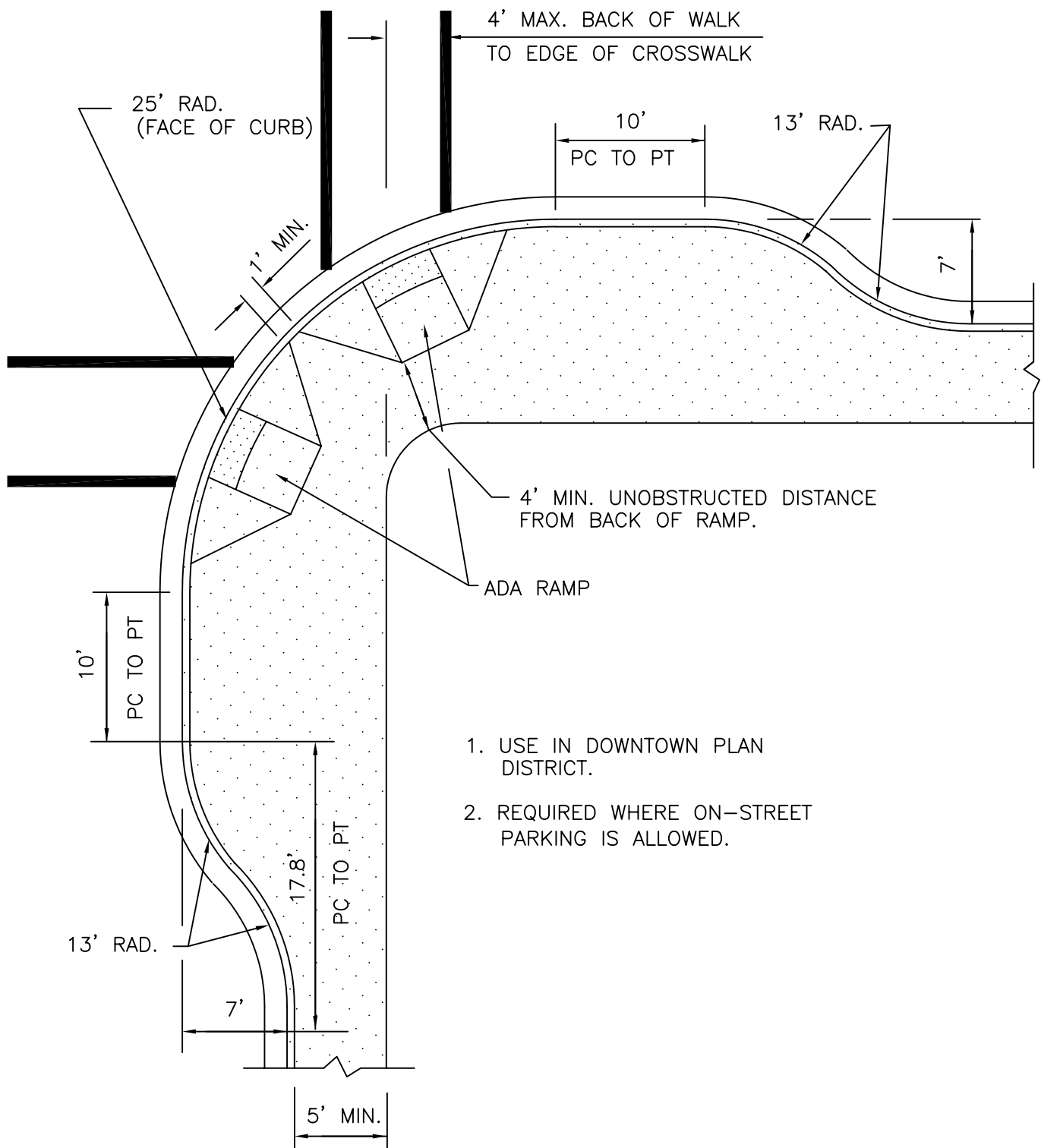
DRAWN	TA	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE	APPR.		APPR.	<i>[Signature]</i>
				DWG. NO.	625

PARALLEL SIDEWALK RAMP



1. TWO SIDEWALK RAMPS PER CORNER ARE REQUIRED AT ALL NEW INTERSECTIONS. RAMPS SHALL BE LOCATED WITHIN THE CROSSWALK AND AS NEAR THE CONTINUOUS PEDESTRIAN ROUTE AS PRACTICAL.
2. A SINGLE DIAGONAL RAMP MAY BE USED ONLY WHEN SITE CONSTRAINTS PROHIBIT INSTALLING TWO RAMPS AND APPROVED BY ENGINEER.
3. PLACE TRUNCATED DOME DETECTABLE WARNING TEXTURE IN LOWER 2' OF THROAT OF RAMP ONLY. ARRANGE DOMES USING IN-LINE-PATTERN ONLY AS SHOWN IN DETAIL. COLOR OF TEXTURE TO BE BRICK RED.
4. SEE STANDARD DRAWING NUMBERS 602 AND 603 FOR CURB EXPOSURE DIMENSION "e". MATCH EXISTING "e" FOR RETROFIT APPLICATIONS.
5. SLOPES SHOWN ARE RELATIVE TO HORIZONTAL. SIDE FLARES IN PLANTER STRIP MAY BE OF ANY SLOPE.
6. SIDEWALK RAMPS SHALL BE FORMED AND POURED SEPARATE FROM SIDEWALK AND LANDINGS. COLD JOINTS SHALL BE KEYED OR DOWELLED. EDGES OF THE ACCESSIBLE ROUTE SHALL BE POURED AGAINST RIGID FORMS OR CURED CONCRETE TO ENSURE COMPLIANCE WITH ORS 447.310 AND ADA.
7. DO NOT SLOPE LANDING MORE THAN 2% IN ANY DIRECTION. ADA RAMP CROSS-SLOPE SHALL NOT EXCEED 2% IN NEW CONSTRUCTION.
8. IN ALTERATIONS CURB RAMP SLOPES(S) MAY BE 10% FOR A MAX. RISE OF 6" OR 12.5% FOR A MAX. RISE OF 3". CURB RAMP IN ALTERATIONS NEED NOT EXCEED 6' IN LENGTH. ADA RAMP CROSS-SLOPE MAY BE WARPED TO MATCH EXISTING GUTTER GRADE.

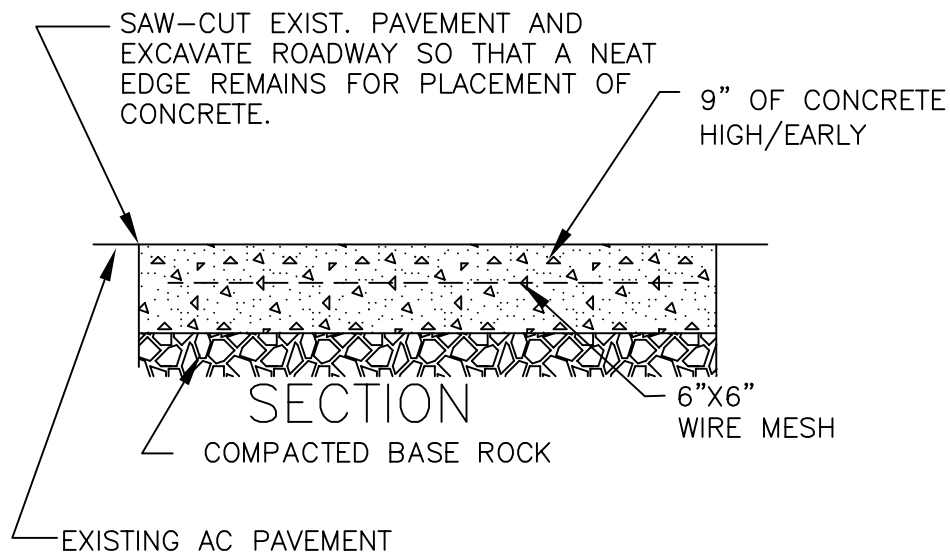
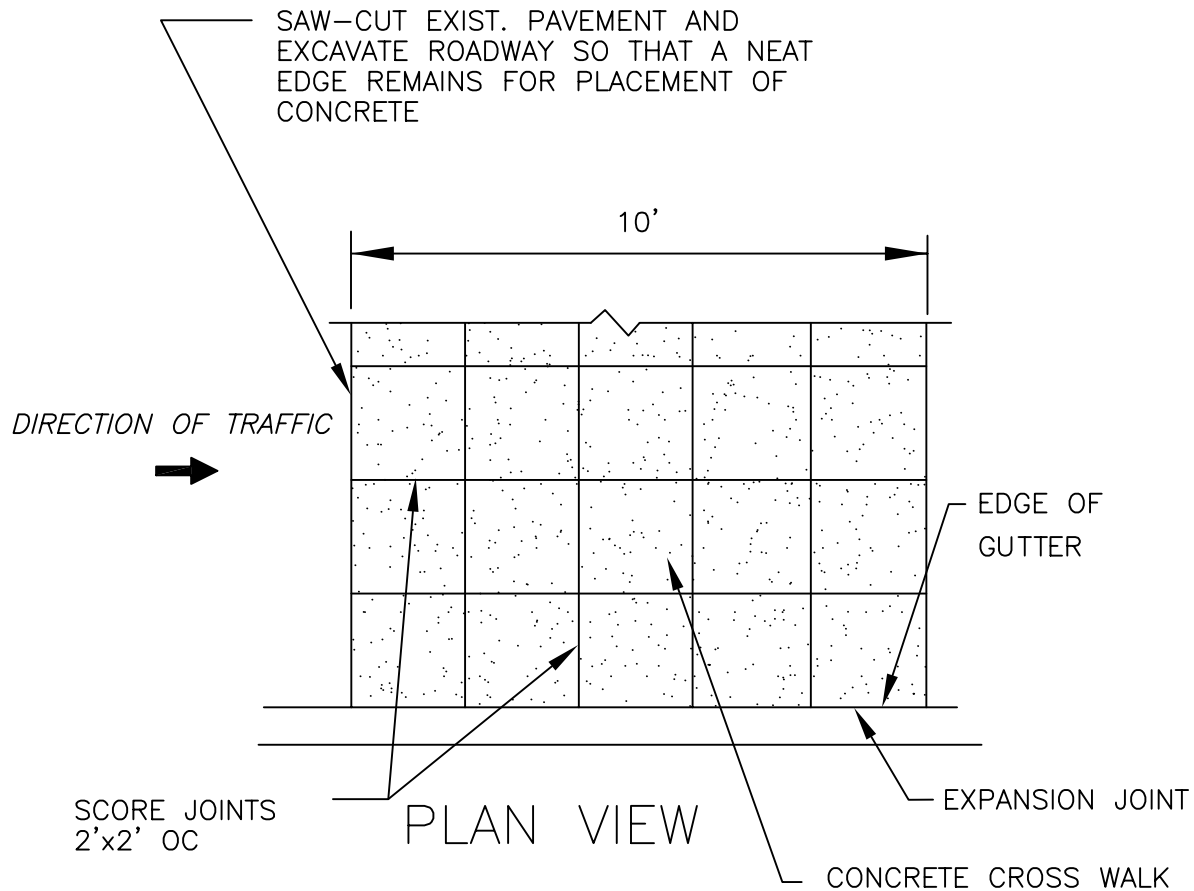
DRAWN	TA	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 PERPENDICULAR SIDEWALK RAMP		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE			APPR.	
				DWG. NO.	626



DRAWN TA		
DIV. TRANSPORTATION		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES	
CITY OF GRESHAM	
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	
DOWNTOWN CURB EXTENSION	

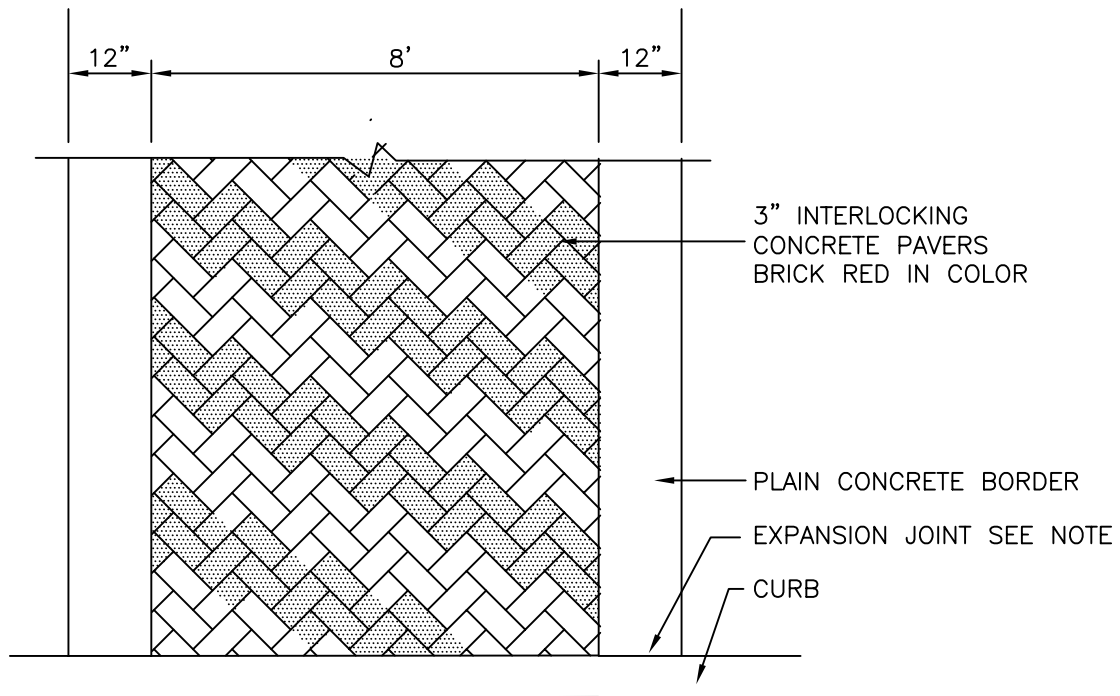
SCALE	NTS
DATE	JAN. 1, 2006
APPR.	<i>OR</i>
DWG. NO.	627



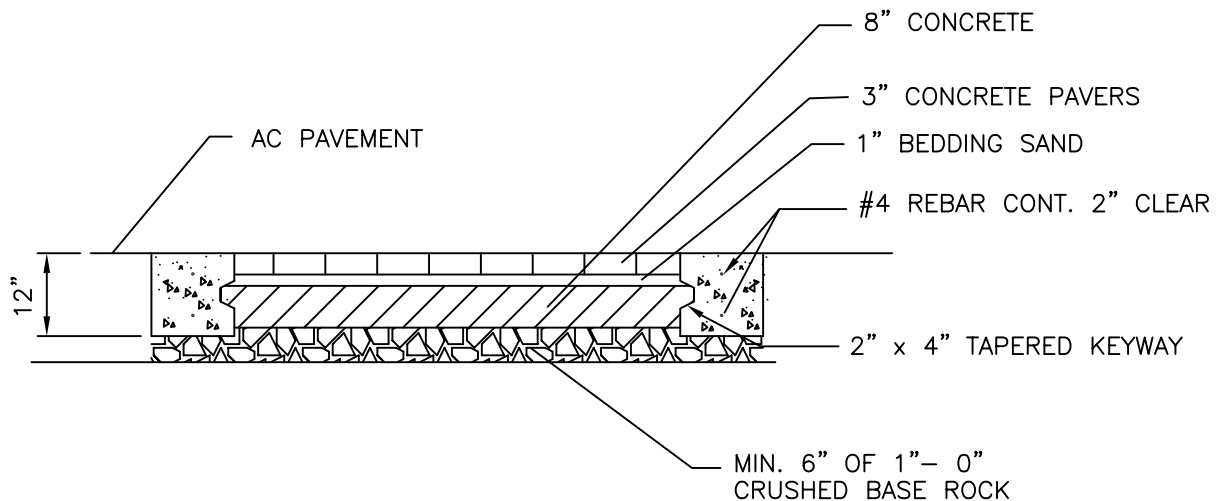
NOTE:
PLACE 1/2" EXPANSION JOINT AT CENTER

DRAWN	AJB	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE			APPR.	<i>OR</i>
				DWG. NO.	628

CONCRETE CROSSWALK DETAIL




PLAN VIEW

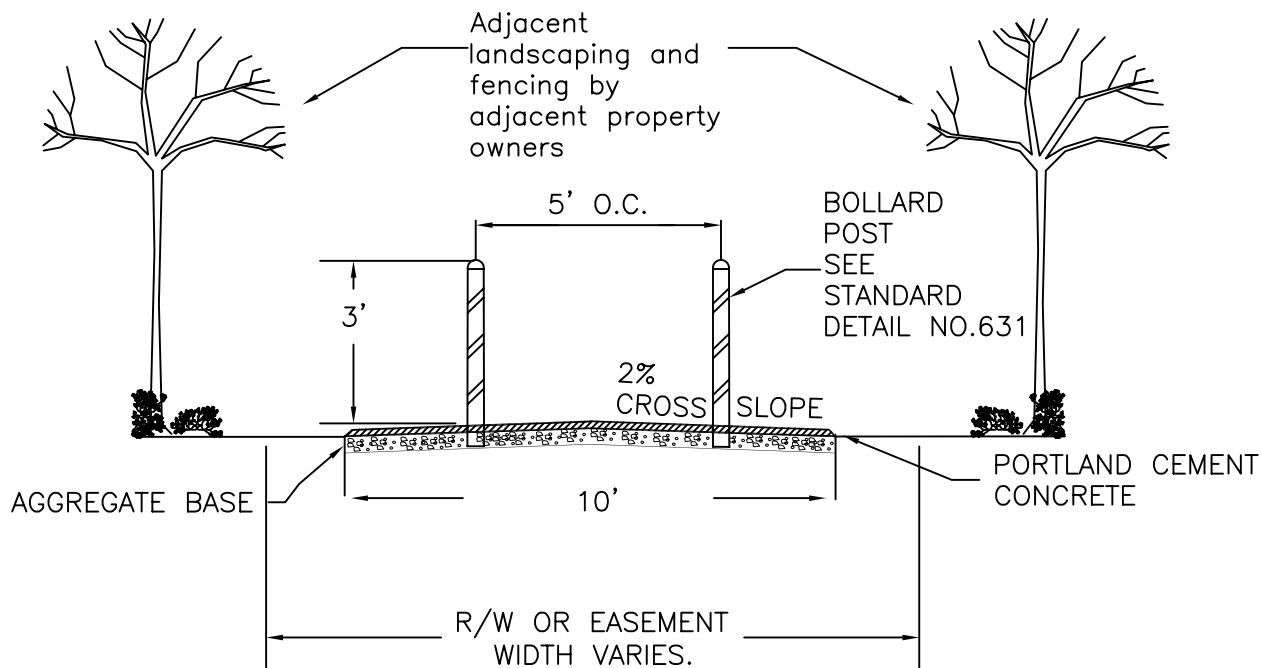


NOTE:

ALL CONC. TO BE 3,300 PSI AT 28 DAYS. PROVIDE
1/2" EXPANSION JOINT AT CENTER
OF CROSSWALK OR AT 15' O.C.

SECTION


DRAWN AJB			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 PAVER CROSSWALK DETAIL	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. 
				DWG. NO. 629



1. PATH SHALL BE CENTERED IN THE RIGHT-OF-WAY OR EASEMENT.
2. IF THE RIGHT-OF-WAY OR EASEMENT IS WIDER THAN 15' THEN THE SHOULDERS SHALL HAVE A WEED BARRIER PLACED ON THE SUBGRADE AND BE COVERED BY 6" OF 3/4"-0 CRUSHED ROCK COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180 OR SHALL BE PORTLAND CEMENT CONCRETE.
3. SUBGRADE AND BASEROCK SHALL BE COMPACTED TO 95% RELATIVE DENSITY PER AASHTO T-180.
4. CONTRACTION JOINTS SHALL BE PLACED AT ALL CHANGES OF DIRECTION, POINTS OF CURVATURE AND AT 15' (MAX) INTERVALS. JOINTS SHALL BE 1/8" TO 1/4" WIDE AND A MINIMUM DEPTH OF 1/3 THE THICKNESS OF THE CONCRETE.
5. ALL SURFACES SHALL BE TROWELED AND BROOMED IN A WORKMANLIKE MANNER. ALL CONTRACTION JOINTS SHALL BE STEEL TROWELED (3 IN. TYP).
6. WHERE LIGHTING IS NEEDED, MEET IES STANDARDS FOR PEDESTRIAN SCALE LIGHTING. STYLE AND HEIGHT MAY VARY (UP TO 12' HEIGHT).
7. WHERE ACCESSWAYS CONTINUE ACROSS STREETS, ADA RAMPS SHALL BE REQUIRED.

USE	AGGREGATE BASE	CONCRETE THICKNESS	CONCRETE STRENGTH	REINFORCEMENT
NONVEHICULAR	2"	6"	3,300 PSI	N/A
HEAVY VEHICLE	6"	8"	5,000 PSI	10 GA. WIRE 6" O.C.

*NOTE: PARK/NATURAL AREA ACCESSWAYS MAY BE PCC OR SOFT SURFACE, BASED ON NATURAL AREA CONSTRAINTS AND ANTICIPATED LEVEL OF USE AS APPROVED BY THE MANAGER.

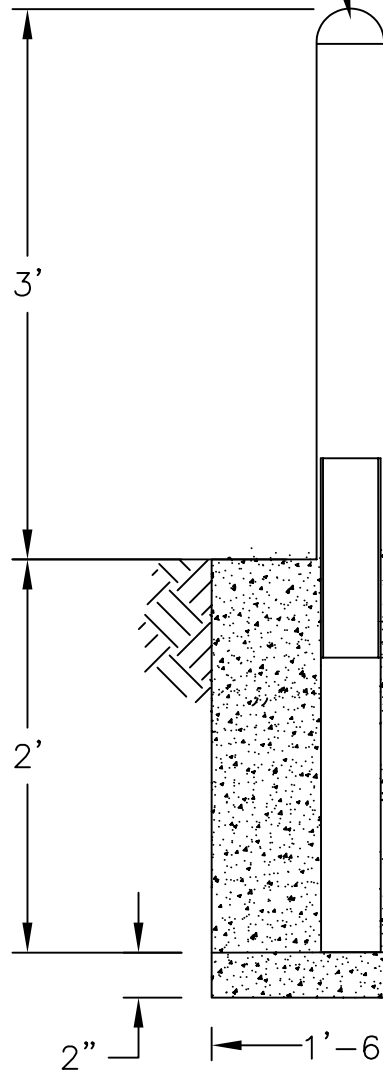
DRAWN			TA	<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>PEDESTRIAN / BICYCLE ACCESSWAY DETAIL</div>	SCALE	N.T.S.
DIV.			TRANSPORTATION		DATE	JAN. 1, 2006
REV.	DATE	APPR.			APPR.	
					DWG. NO.	630

- 1- BOLLARD TO REMOVABLE BOLLARD INSERT
 3- 3/8"-16x3/8" HEX SOCKET
 SET SCREW

INSTALLATION SEQUENCE

1. DIG FOOTING HOLE AND SET POST FOOTING SLEEVE PLUM AND SQUARE IN CONCRETE (BY OTHERS)
2. INSERT REMOVABLE BOLLARD INSERT INTO BOLLARD.
3. TIGHTEN HEX SOCKET SET SCREWS.
4. SET THE BOLLARD AND REMOVABLE BOLLARD INSERT INTO THE POST FOOTING SLEEVE.

POST W/ DOME TOP



METAL BOLLARD COLUMBIA CASCADE #2190-R
 OR APPROVED EQUAL
 (POWDER-COATED EVERGREEN)

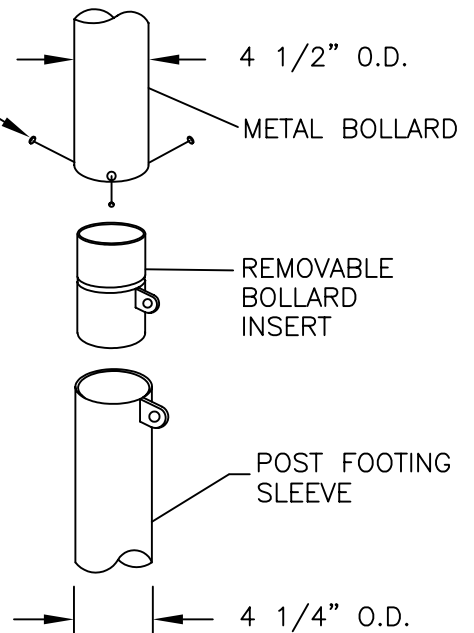
REMOVABLE BOLLARD INSERT

POST FOOTING SLEEVE

3300 PSI
 CONCRETE

COMPACTED 3/4"-0
 CRUSHED AGGREGATE

UNDISTURBED EARTH



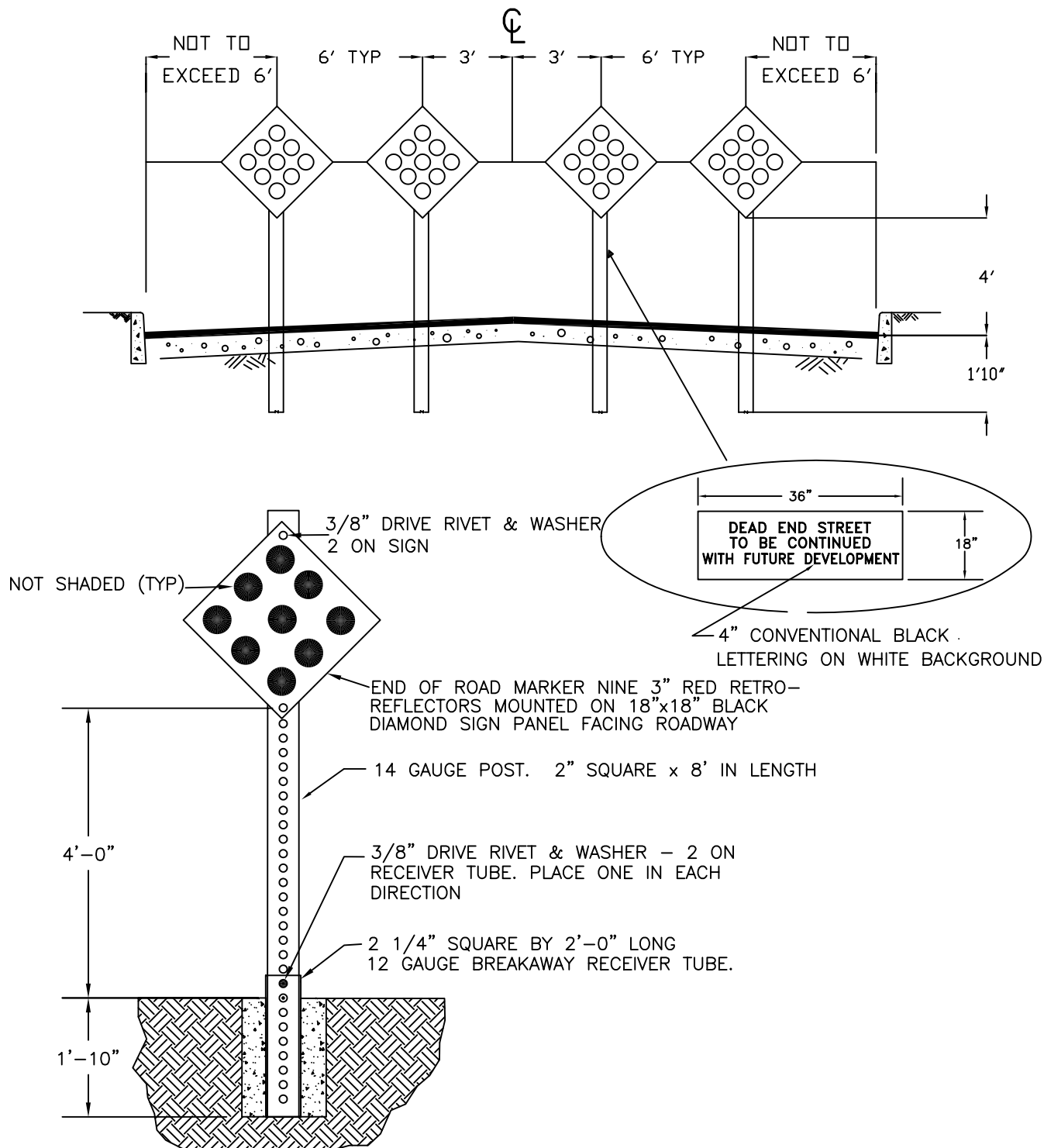
NOTES:

- 1: LOCK TAB TO BE ORIENTED OPPOSITE THE DIRECTION OF VEHICULAR ACCESS.
- 2: DECORATIVE STANDARD BOLLARD MAY BE APPROVED BY THE MANAGER.
 SEE STANDARD DETAIL DRAWING 630 FOR ACCESSWAY DETAIL.

DRAWN	TA
DIV.	TRANSPORTATION
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
BOLLARD DETAIL

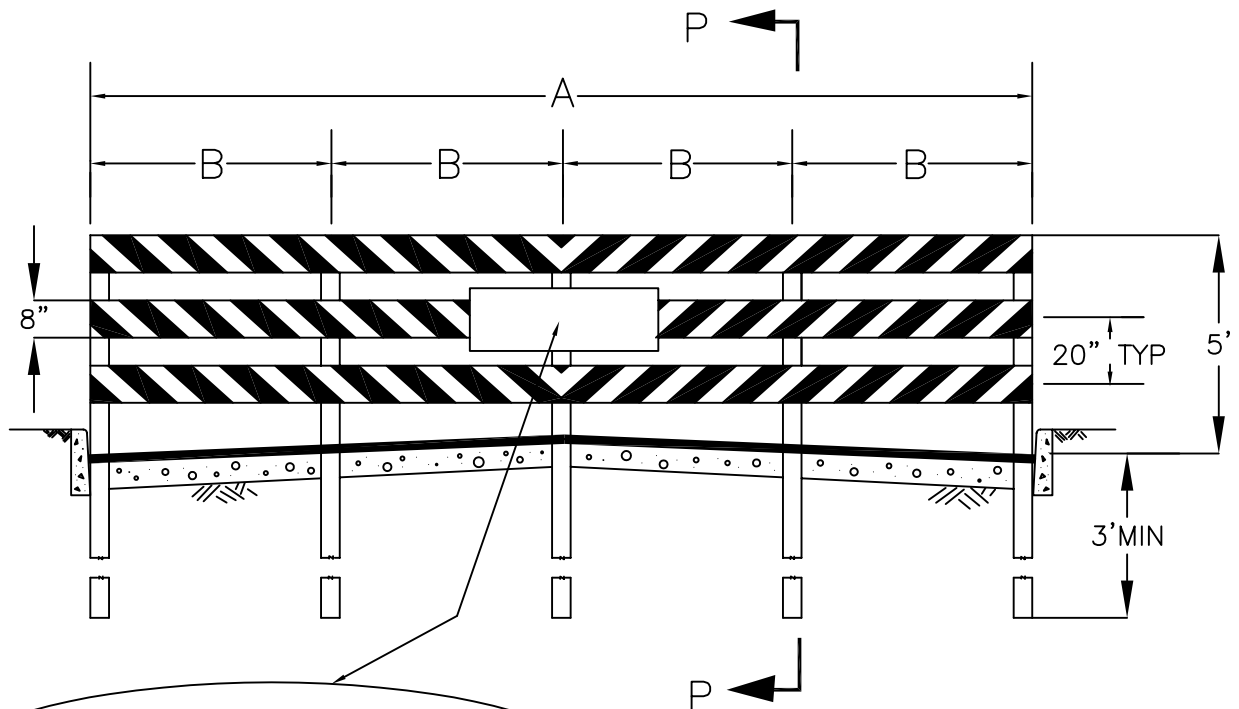
SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	631



NOTES:

1. END OF ROAD MARKERS SHALL BE USED IN LIEU OF STREET BARRICADE WHERE NO DROP OFF HAZARD (SLOPES STEEPER THAN 3:1 FOR 18" OR GREATER VERTICALLY) EXISTS.
2. PLACE POSTS 3' LEFT AND RIGHT OF CENTERLINE AND SPACE ADDITIONAL POSTS AT 6' INTERVALS.
3. ANCHOR SHALL BE COVERED BY DUCT TAPE ON ALL SIDES.
4. POST SHALL BE SPRAYED WITH ANTI-SIEZE ON THE BOTTOM 2'.

DRAWN	TA	DEPARTMENT OF ENVIRONMENTAL SERVICES		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE	APPR.	1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		APPR. <i>OR</i>
			END OF ROAD MARKERS		DWG. NO. 632



4" CONVENTIONAL BLACK LETTERING ON WHITE BACKGROUND

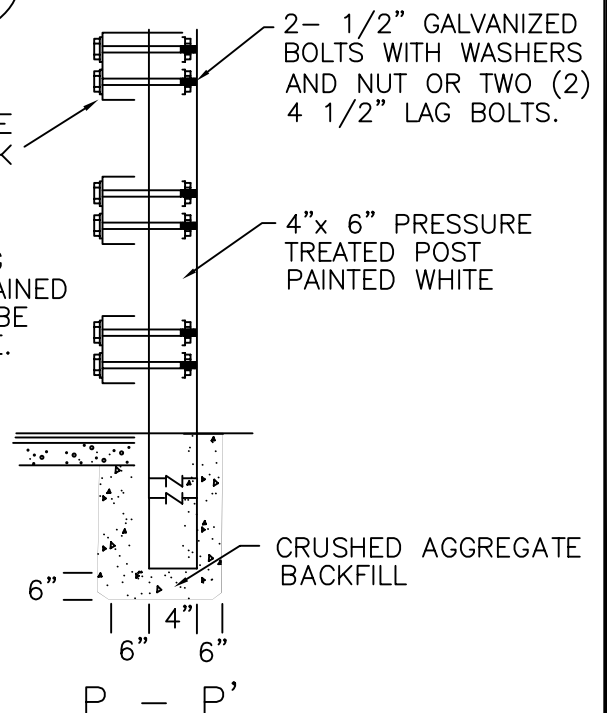
2" PRESSURE TREATED PLANK

A*	B
40'	10'
36'	9'
32'	8'

* FOR STREETS THAT DO NOT FIT STANDARD WIDTHS EQUAL SPACING BETWEEN POSTS SHALL BE MAINTAINED NOT TO EXCEED 10' AND SHALL BE CENTERED ON STREET CENTERLINE.

NOTES:

1. STRIPING SHALL BE ALTERNATING RED (RODDA #1249 OR EQUAL) AND WHITE STRIPES 6" IN WIDTH AT A 45 DEGREE ANGLE AND SHALL BE EITHER RETRO-REFLECTIVE TAPE OR PAINTED WITH A SEALED RETRO-REFLECTIVE SURFACE.
2. THIS BARRICADE SHALL CONFORM TO SECTION 3F-I, UNIFORM MANUAL ON TRAFFIC CONTROL DEVICES-FHWA.



DRAWN	TA
DIV.	TRANSPORTATION
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

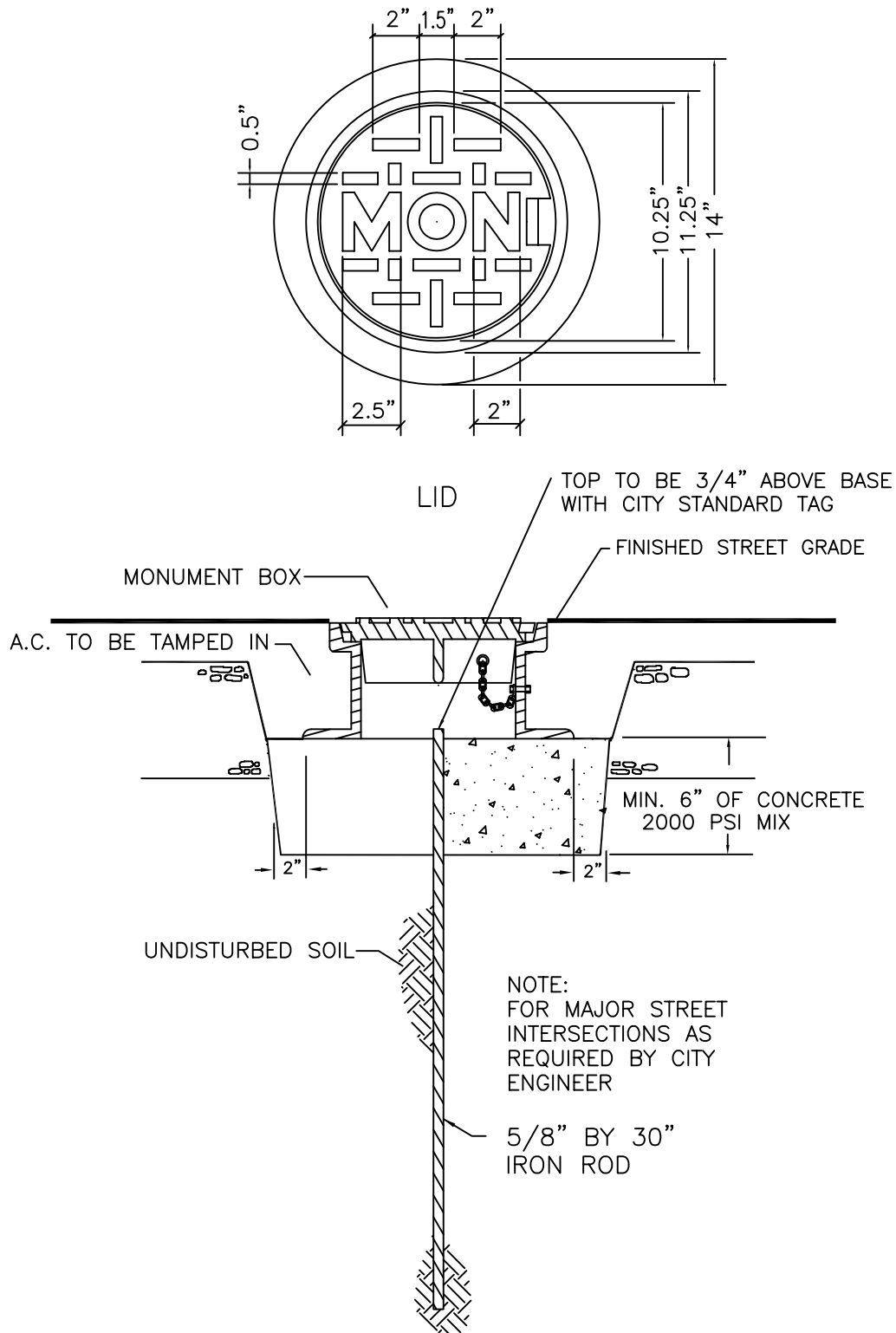
STREET BARRICADE

SCALE N.T.S.


DATE JAN. 1, 2006

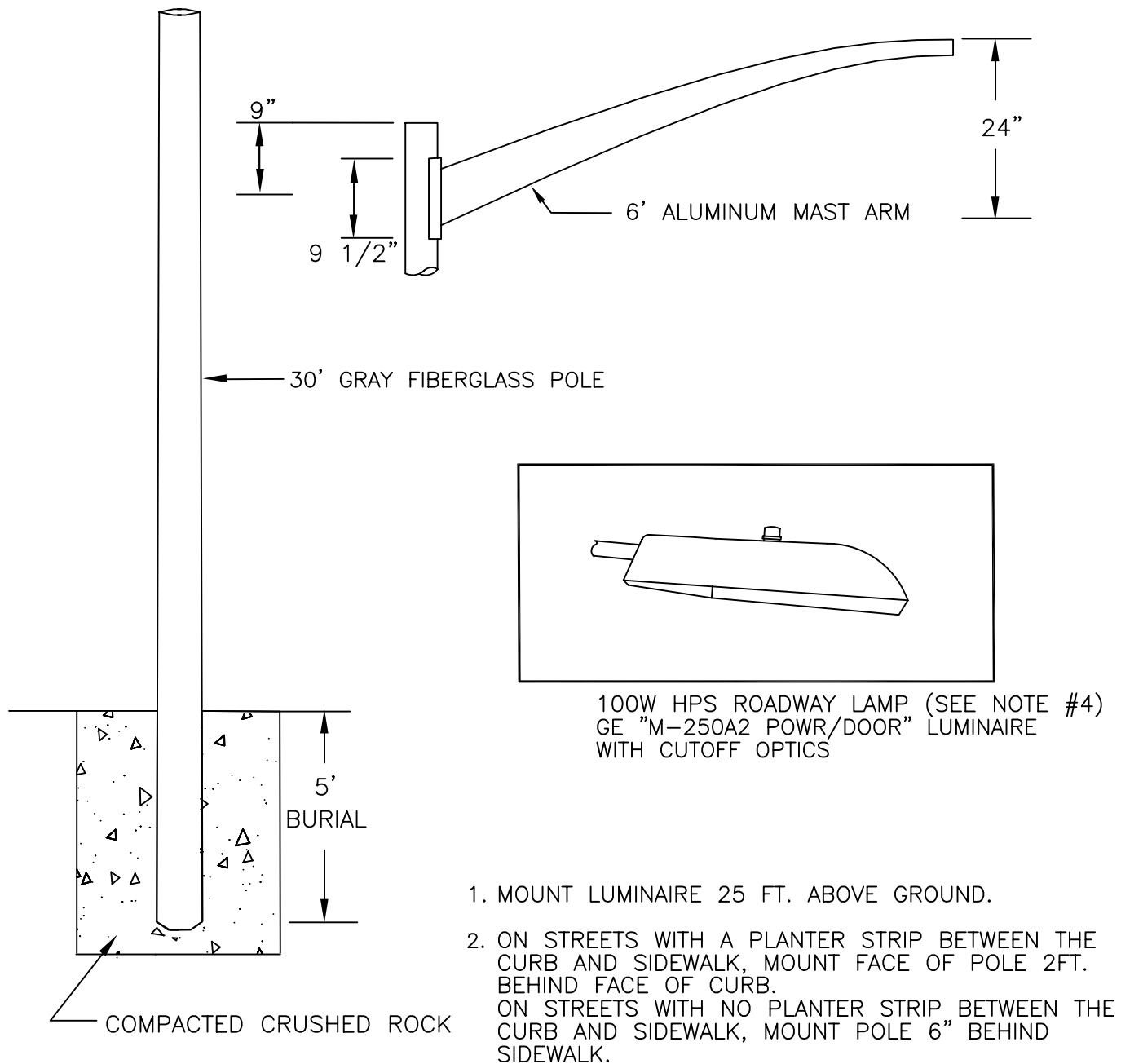
APPR. *OR*

DWG. NO. 633



PLACEMENT OF BRASS CAP AND MONUMENT BOX SHALL FOLLOW
MULTNOMAH COUNTY SURVEYORS OFFICE STANDARDS.

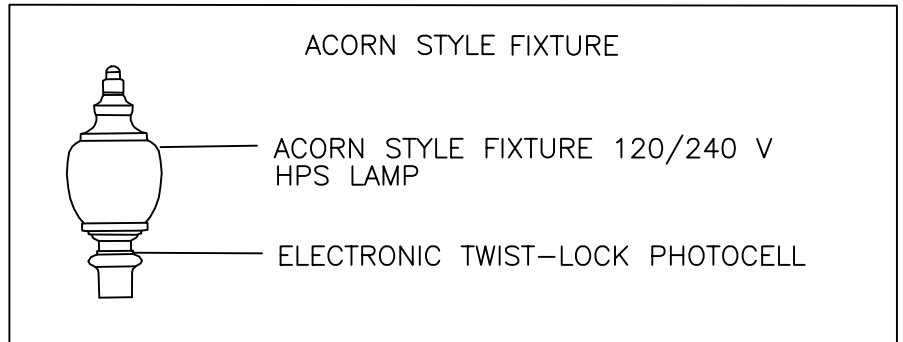
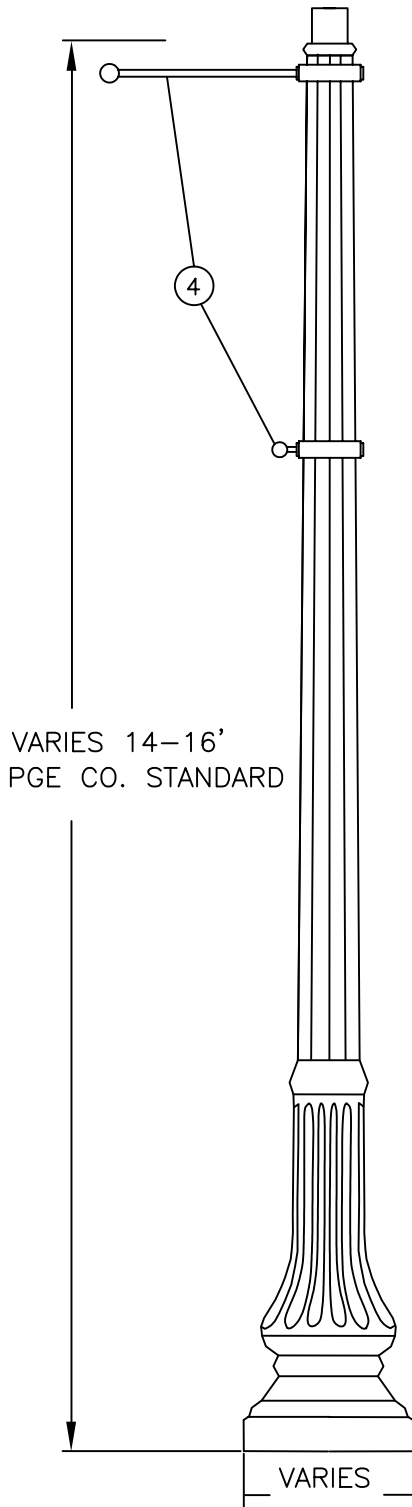
DRAWN			MRM			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030 STANDARD MONUMENT BOX	SCALE	N.T.S.
DIV. TRANSPORTATION							DATE	JAN. 1, 2006
REV.	DATE	APPR.					APPR.	
							DWG. NO.	634



1. MOUNT LUMINAIRE 25 FT. ABOVE GROUND.
2. ON STREETS WITH A PLANTER STRIP BETWEEN THE CURB AND SIDEWALK, MOUNT FACE OF POLE 2FT. BEHIND FACE OF CURB.
ON STREETS WITH NO PLANTER STRIP BETWEEN THE CURB AND SIDEWALK, MOUNT POLE 6" BEHIND SIDEWALK.
3. ALL MATERIALS SHALL BE PGE APPROVED.
4. COLLECTOR STREETS AND ABOVE WILL REQUIRE 150W-250W HPS. VERIFY CORRECT WATTAGE AND POLE MOUNTING HEIGHT WITH CITY.


DRAWN	MRM	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE	APPR.		APPR.	<i>OR</i>
				DWG. NO.	635

STANDARD STREET LIGHT DETAIL

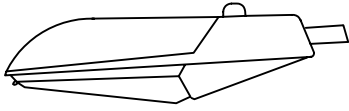


ILLUMINAIRE: 150-200 WATT -16' POLE (SEE NOTE #7)
100 WATT -14' POLE

1. FLUTED TAPERED POLE, COLOR BLACK
USE 14' POLE ON LOCAL STREETS
USE 16' POLE ON COLLECTOR STREETS
2. ON STREET WITH PLANTER STRIP BETWEEN THE CURB AND SIDEWALK, MOUNT POLE 2 FT. BEHIND FACE OF CURB. ON STREET WITH NO PLANTER STRIP MOUNT POLE AT CITY ENGINEERS DIRECTION.
3. USE UTILITY VAULT PRECAST CONCRETE FOOTING NO. 20R-LB-4-PGE WITH AN 11" BOLT CIRCLE FOR SIDEWALK LOCATIONS.
4. BANNER ARM/PLANT HANGER REQUIRED IN DOWNTOWN DISTRICT.
5. ALL MATERIALS SHALL BE PGE APPROVED.
6. DECORATIVE LIGHTING OUTSIDE OF DOWNTOWN AND SPECIAL COMMERCIAL DISTRICTS MUST BE APPROVED BY THE CITY ENGINEER.
7. LUMINAIRE WATTAGE TO BE DETERMINED BY CITY.

DRAWN			MRM		<div>DEPARTMENT OF ENVIRONMENTAL SERVICES</div> <div>CITY OF GRESHAM</div> <div>1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030</div> <div>DECORATIVE LIGHTING POLE DETAIL</div>	SCALE		N.S.	
DIV.			TRANSPORTATION			DATE		JAN. 1, 2006	
REV.	DATE	APPR.				APPR.			
						DWG. NO.		636	

GE "POWER DOOR" FIXTURE
FLAT LENS STYLE HPS LAMP



NOTES:

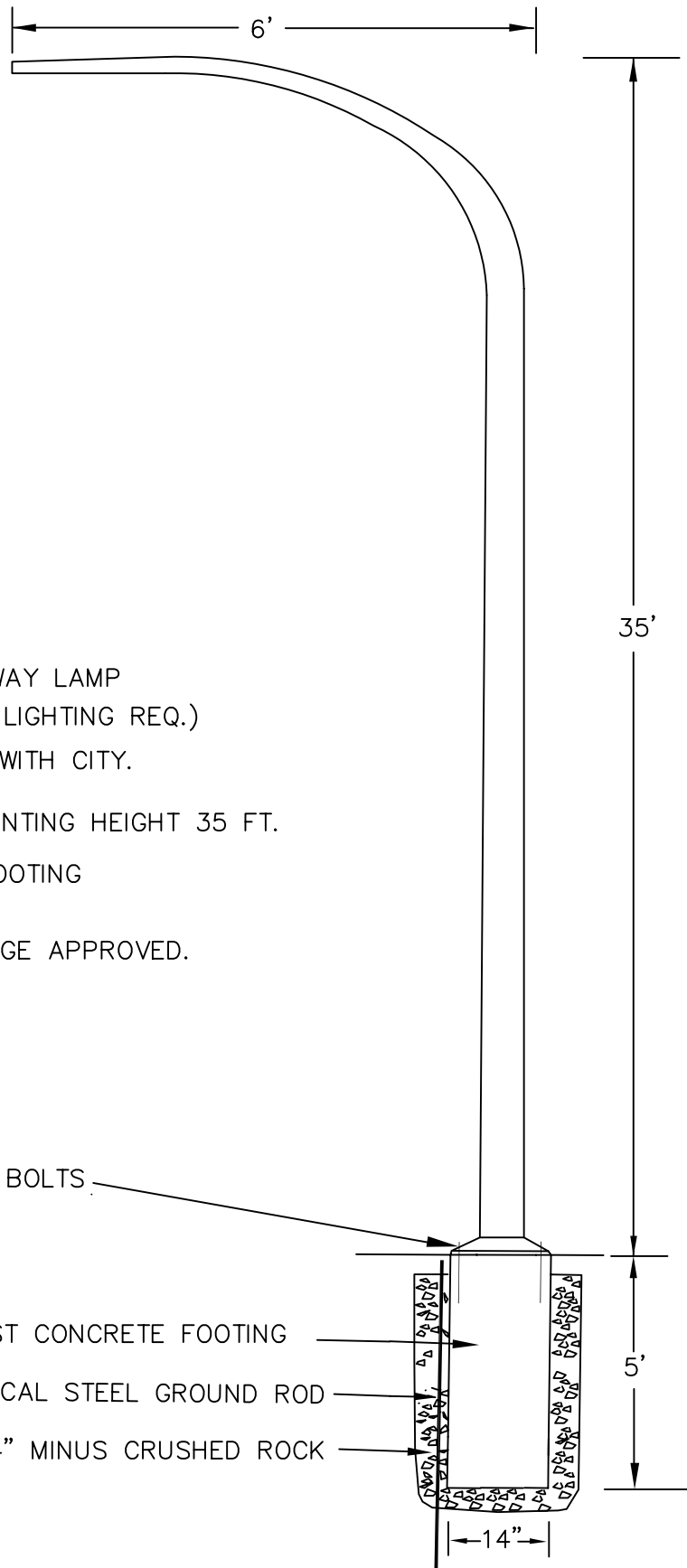
1. 250-400 WATT HPS ROADWAY LAMP
(WILL VARY DEPENDING ON LIGHTING REQ.)
VERIFY CORRECT WATTAGE WITH CITY.
2. ALUMINUM DAVIT POLE MOUNTING HEIGHT 35 FT.
3. USE PRECAST CONCRETE FOOTING
PGE # 5CL-LB OR EQUAL.
4. ALL MATERIALS SHALL BE PGE APPROVED.

FOUR 1" DIAM. GAL. STEEL BOLTS
ON 11 INCH BOLT CIRCLE
WITH 3 1/2" PROJECTION

PRECAST CONCRETE FOOTING

5/8" X 8' VERTICAL STEEL GROUND ROD

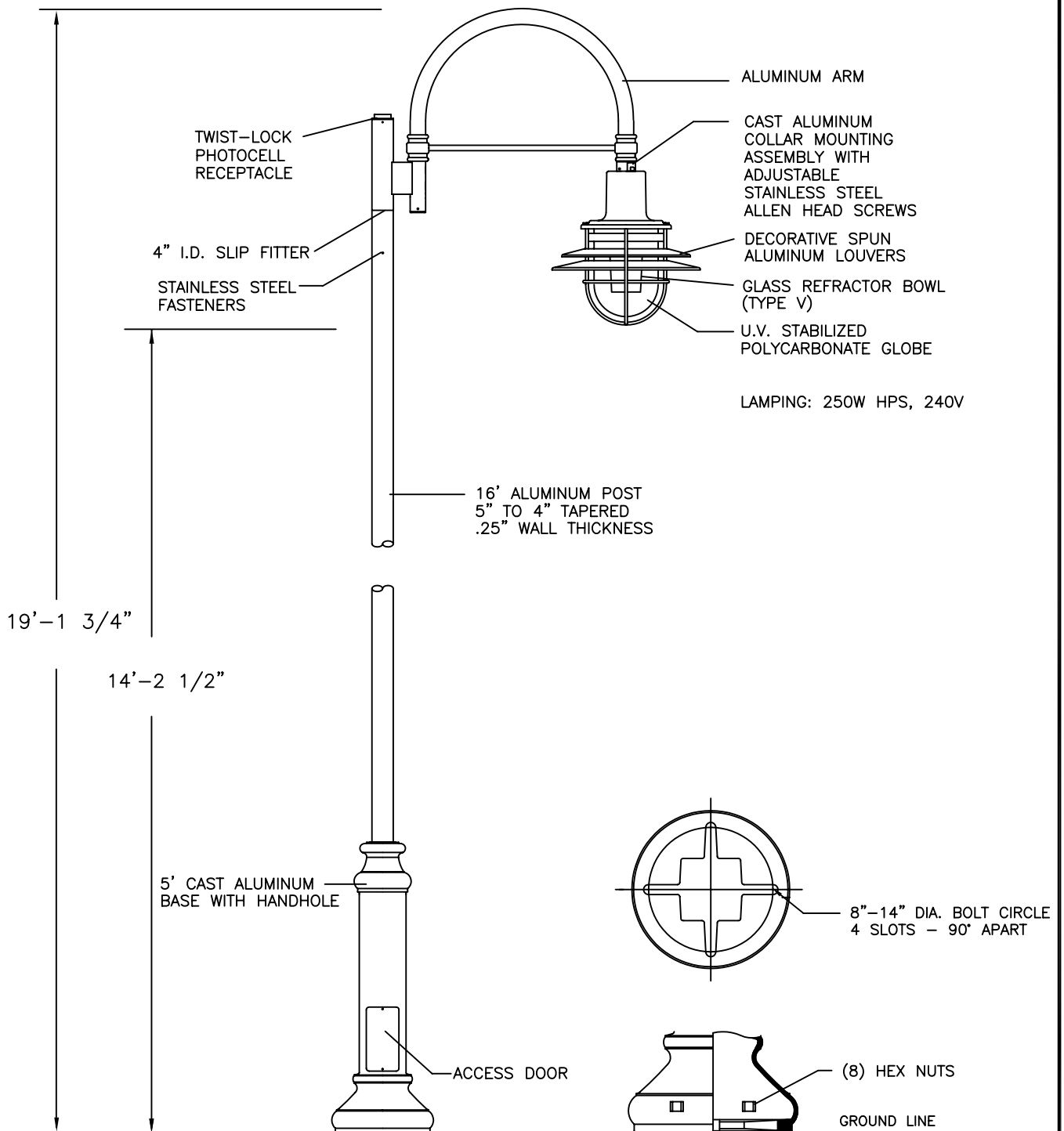
COMPACTED 3/4" MINUS CRUSHED ROCK



DRAWN	MRM	
DIV.	TRANSPORTATION	
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES		
CITY OF GRESHAM		
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		
ARTERIAL STREET LIGHT DETAIL		

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	637



FIXTURE = S5980

POST = SP5980

ARM = SA5980

HADCO

USE UTILITY VAULT PRECAST FOOTING NO. 20R-LB-4-PGE

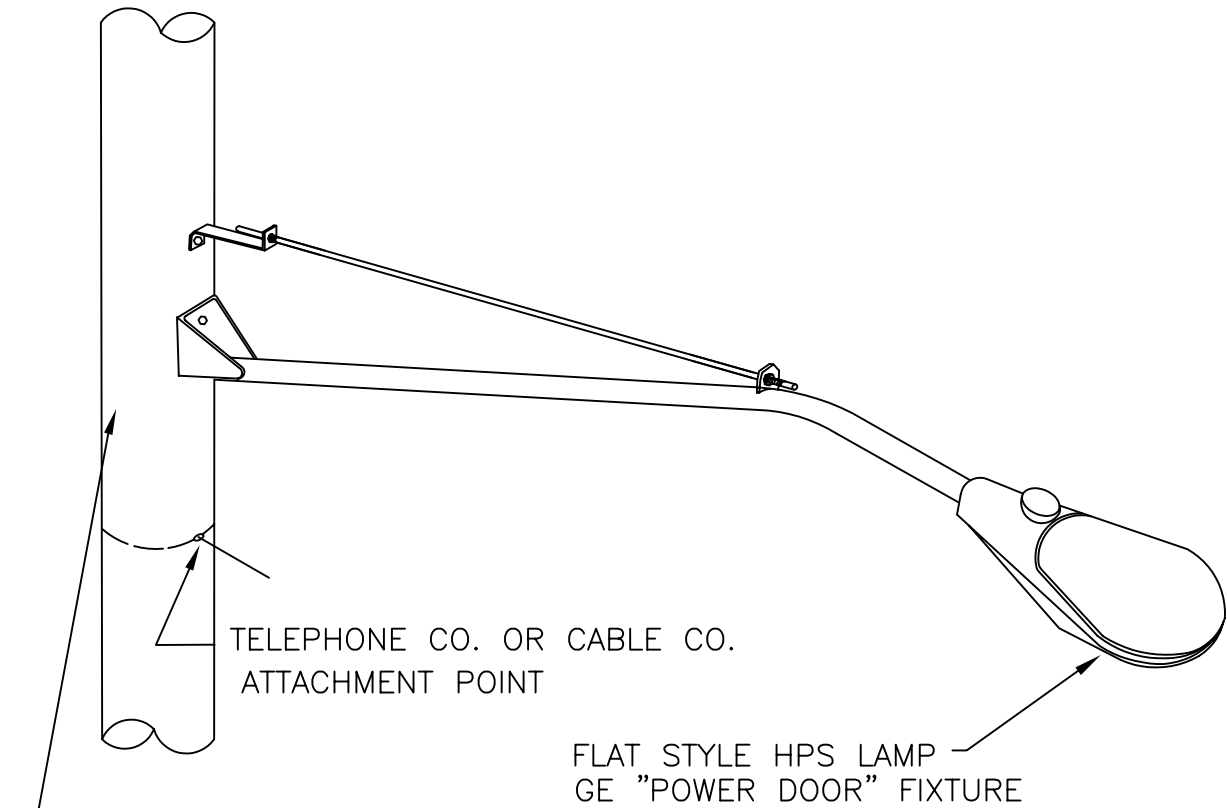
ALL MATERIALS SHALL BE PGE APPROVED.

DRAWN	M.R.M.
DIV.	TRANSPORTATION
REV.	DATE
	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
ARCHITECTURAL STREETLIGHT

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>CR</i>
DWG. NO.	638

LUMINAIRE MOUNTED ON EXISTING POLE

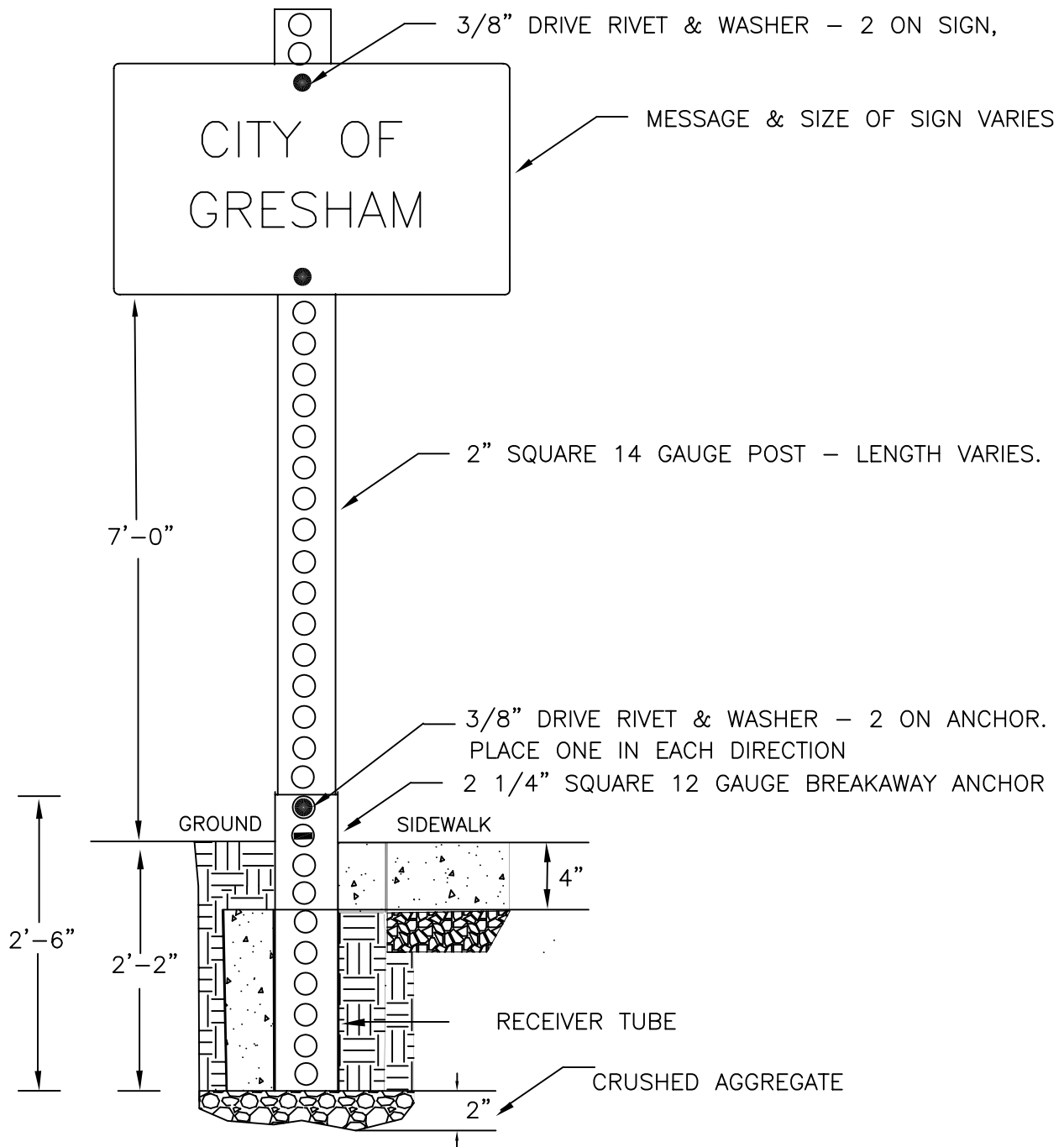


POLE: EXISTING WOOD POLE

NOTES:

1. WATTAGE REQUIREMENTS WILL VARY DEPENDING ON LIGHTING REQUIREMENTS.
2. MAST ARM LENGTH WILL VARY.
3. VERIFY WATTAGE AND MAST ARM LENGTH WITH CITY.
4. ALL MATERIALS SHALL BE PGE APPROVED.

DRAWN MRM			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.S.
ENGR. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR.
				DWG. NO. 639
			MAST ARM DETAIL	

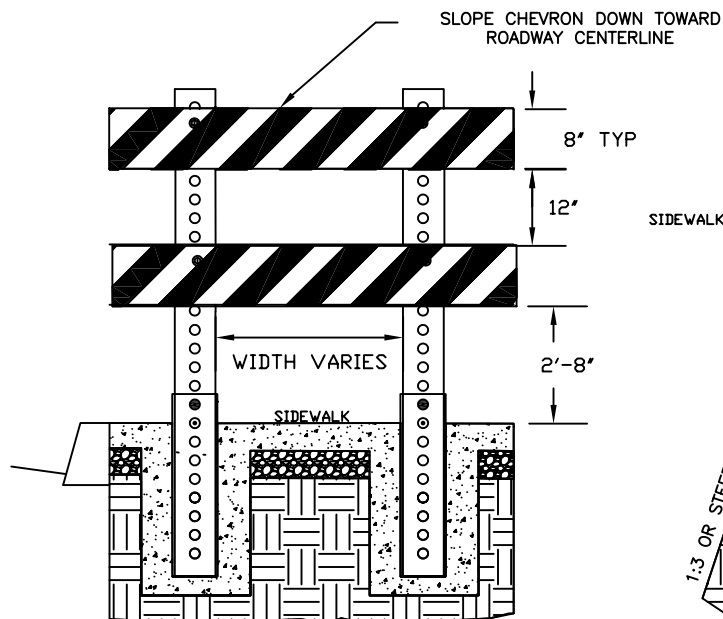
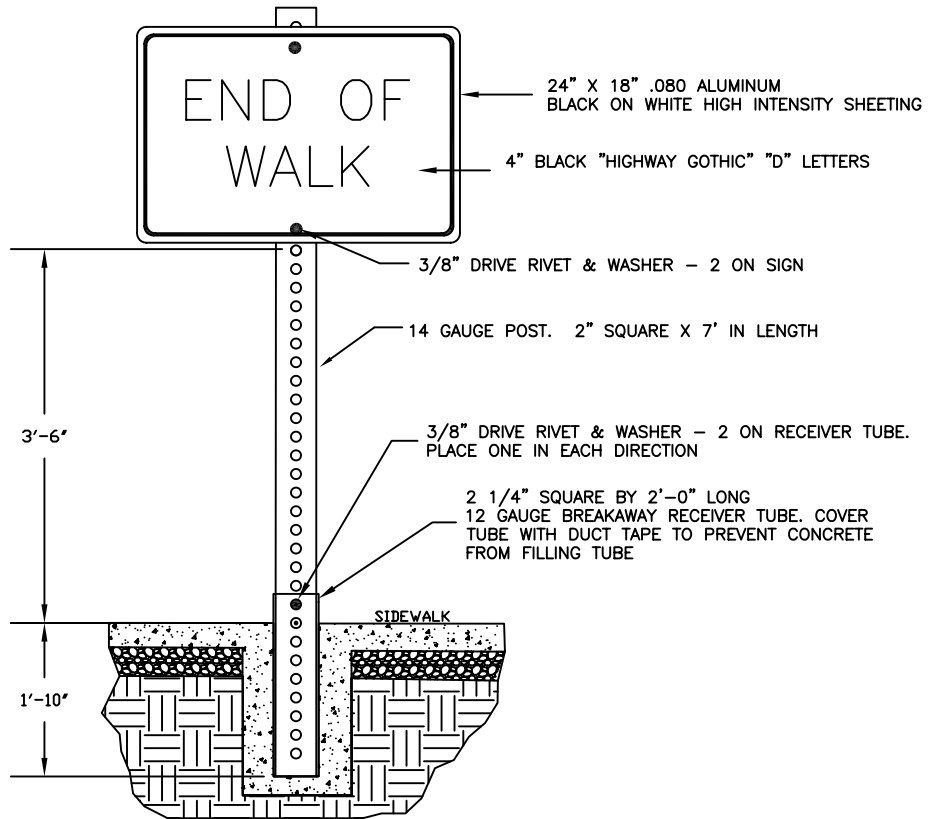


1. ANCHOR SHALL BE COVERED BY DUCT TAPE ON ALL SIDES.
2. ANCHOR SHALL BE SET IN 22" OF CONCRETE UNLESS IN SIDEWALK.
3. IF RECEIVER TUBE IS SET IN SIDEWALK IT SHALL BE 2'-2" DEEP & BACKFILLED WITH COMPACTED FILL, THEN CONCRETE FROM BOTTOM TO TOP OF WALK.
4. SIGN PLACEMENT IN SIDEWALK SHALL ALLOW FOR 5' CLEAR PASSAGE & SIGN POST SHALL BE 12" FROM BACK OF CURB.
5. POST SHALL BE SPRAYED WITH ANTI-SEIZE ON THE BOTTOM 2'-6".

DRAWN	TA	DEPARTMENT OF ENVIRONMENTAL SERVICES		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE	APPR.	CITY OF GRESHAM		APPR. <i>CR</i>
			1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		DWG. NO. 640
			STANDARD SIGNPOST		

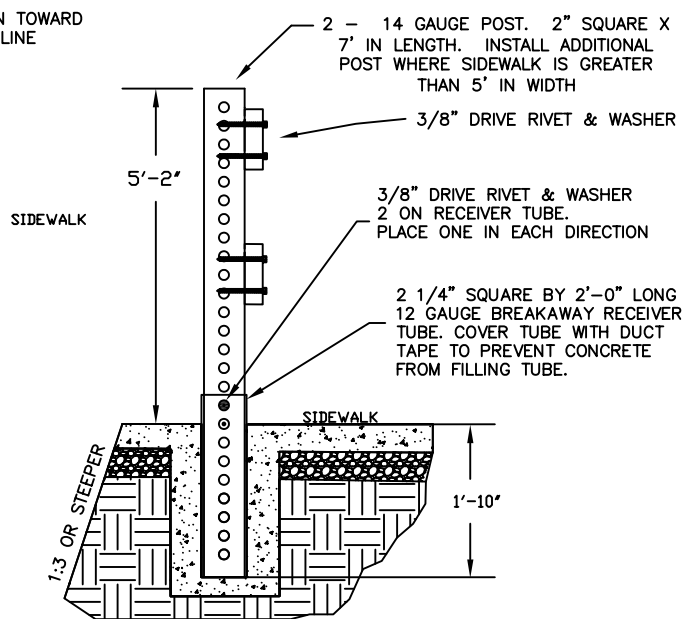
NOTES

1. TO BE USED WHERE SIDEWALK HAS A DROP-OFF OF LESS THAN 18".
2. CENTER POST(S) ON SIDEWALK 6" PAST END OF SIDEWALK. WHEN POST(S) MUST BE SET IN THE SIDEWALK THEN THE SIDEWALK MUST HAVE A TOOLED CONTRACTION JOINT INSTALLED 12" IN FRONT OF POST(S).



NOTES

1. TEMPORARY ASPHALT ADA RAMP MAY BE USED INSTEAD OF BARRICADES OR SIGNAGE.
2. TYPE II BARRICADE TO BE USED WHERE SIDEWALK DROP-OFF EXCEEDS 18" VERTICAL WITH A SLOPE OF 1:3 OR STEEPER.
3. STRIPING FOR TYPE II BARRICADE: TYPE 1 RETRO-REFLECTIVE SHEET WITH ALTERNATING 6" RED AND WHITE STRIPES PLACED AT A 45 DEGREE ANGLE SHALL BE PLACED ON A 7 1/4" X 48" MIN. .080 GAGE ALUMINUM PANEL. PANEL TO BE ATTACHED TO 2" PRESSURE TREATED PLANK WITH 6 #8-3/4" SELF-TAPPING VANDAL PROOF SCREWS.
4. CENTER POST(S) ON SIDEWALK 6" PAST END OF SIDEWALK. WHEN POST(S) MUST BE SET IN THE SIDEWALK THEN THE SIDEWALK MUST HAVE A TOOLED CONTRACTION JOINT INSTALLED 12" IN FRONT OF POST(S).

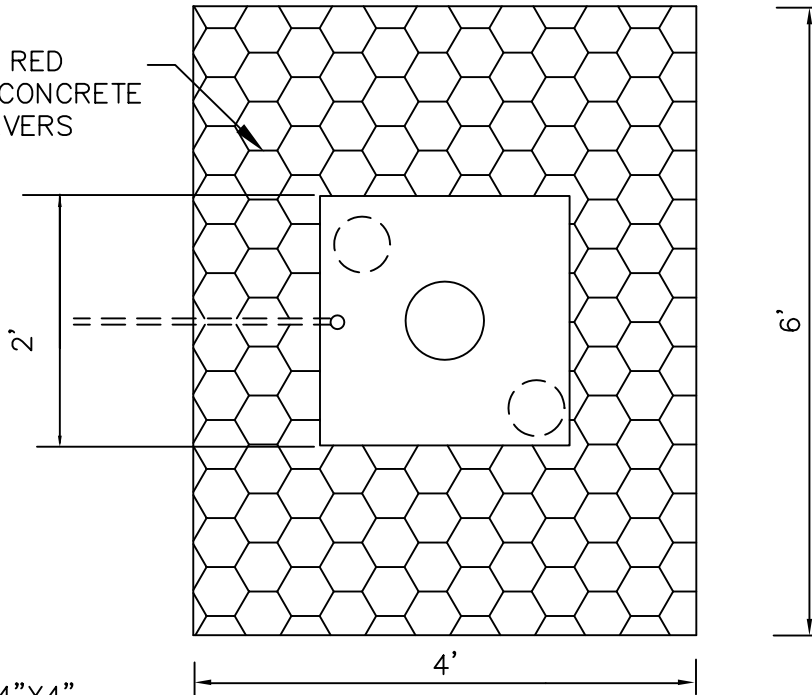


DRAWN			DRB		
DIV. TRANSPORTATION					
REV.		DATE		APPR.	

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM
1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030
END OF SIDEWALK BARRICADE

SCALE	N.T.S.
DATE	JAN. 1, 2006
APPR.	<i>[Signature]</i>
DWG. NO.	641

INSTALL BRICK RED
INTERLOCKING CONCRETE
PERMEABLE PAVERS



PLAN

1 3/4" DIA. CALIPER TREE HEADED @ 6'
TYP. EXCEPT 2" DIA CALIPER HEADED @ 8'
SHALL BE USED WHEN TREE IS IN VISION
TRIANGLE. TREES SHALL BE WELL
BRANCHED, BALLED AND BURLAPED.

IN-GROUND 4"x4"
JUNCTION BOX IN
BACK OF WALK (ON
COMMERCIAL PROPERTY
ONLY)

USE SAME ROCK AS USED TO
FILL VOIDS IN PAVERS 1/4"-#10 TYP

PAVER EDGER

1" OF COARSE SAND

2" OF 3/4"-0 CRUSHED
ROCK

SIDEWALK

BRICK RED PERMEABLE
CONCRETE PAVERS

CURB & GUTTER

GEOTEXTILE FABRIC

GEOTEXTILE FABRIC

12"
MIN

1" ELECT. CONDUIT
CONNECT TO ADJACENT
PROPERTY. (AT COMMERCIAL
PROPERTY ONLY)

UNDISTURBED SOIL

SOIL MIXTURE (SEE SPECS)

SCARIFY SIDES OF PLANTING PIT

(2) 4" PERF. PVC DRAIN PIPE
FILLED WITH 1" WASHED RIVER ROCK

DRAWN TA		
DIV. TRANSPORTATION		
REV.	DATE	APPR.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY OF GRESHAM

1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030

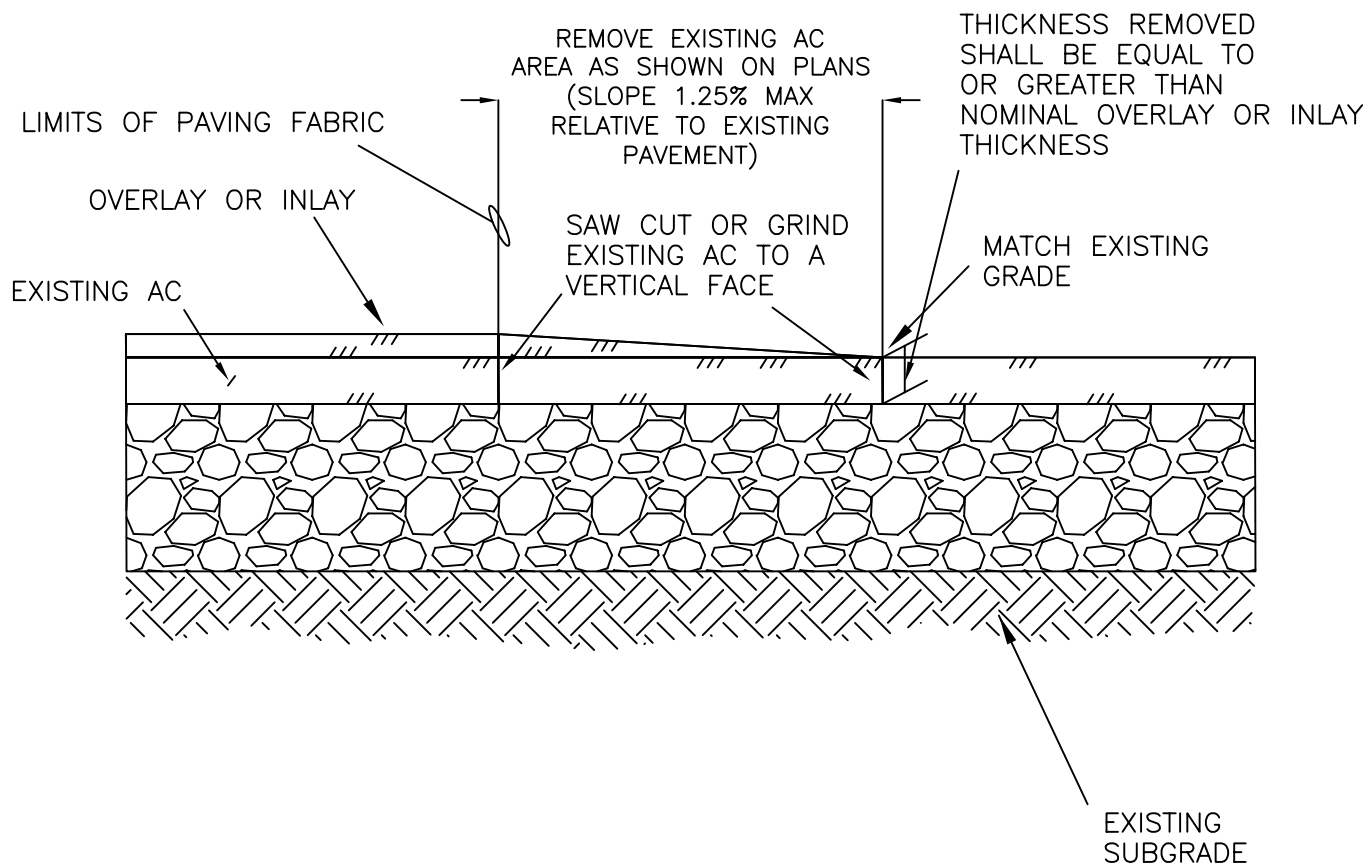
TREE WELL DETAIL

SCALE N.T.S.

DATE JAN. 1, 2006

APPR. *CR*

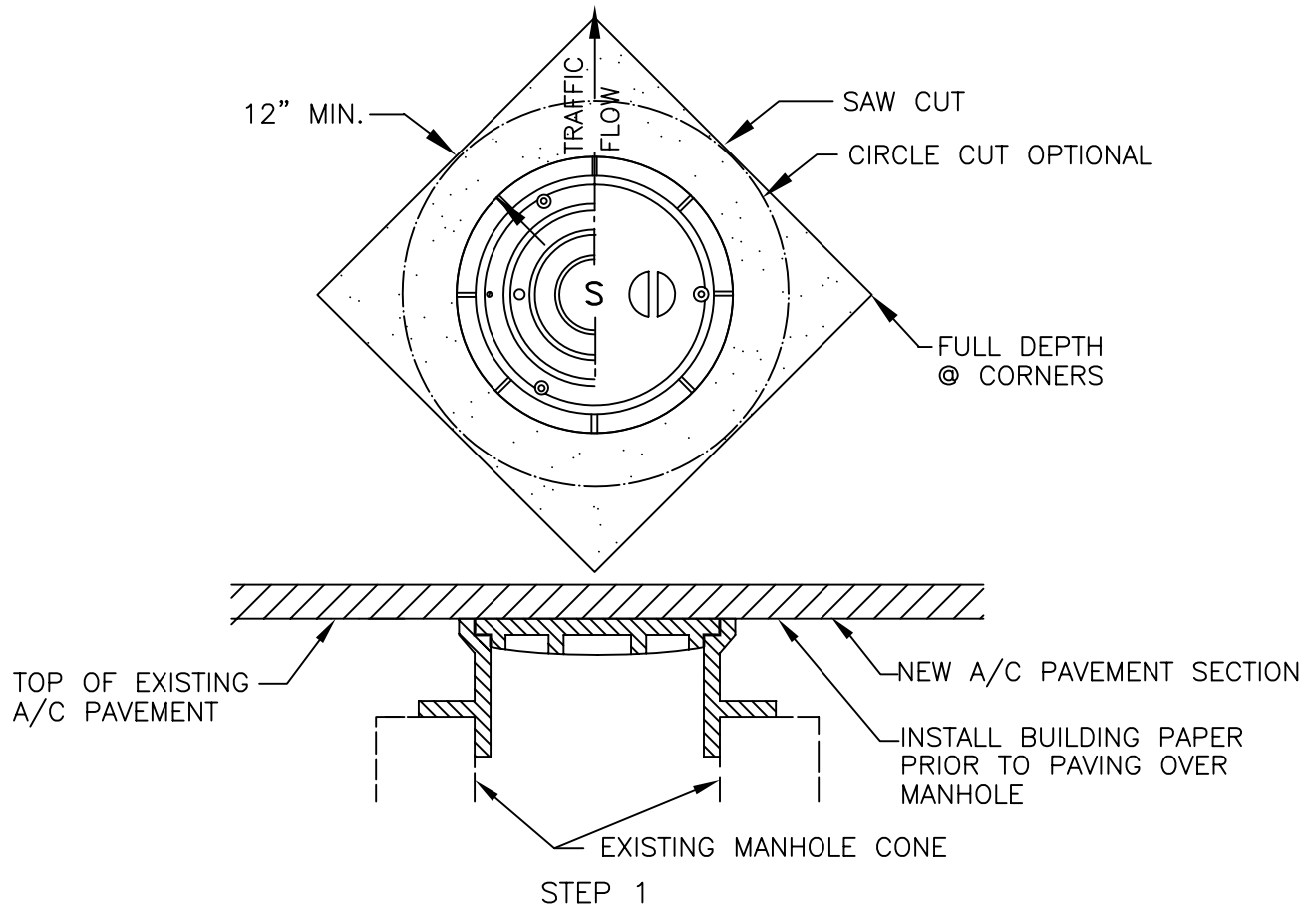
DWG. NO. 642



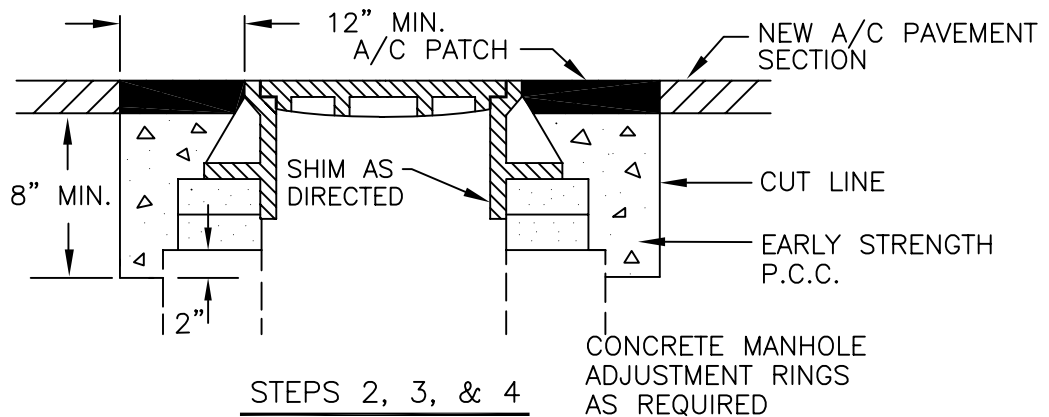
NOTES:

1. ALL SURFACES SHALL BE PROPERLY PREPARED AND TACKED PRIOR TO PLACEMENT OF ASPHALT.
2. ASPHALTIC CONCRETE SHALL BE COMPACTED TO 91% RICE DENSITY.


DRAWN TA			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	SCALE N.T.S.
DIV. TRANSPORTATION				DATE JAN. 1, 2006
REV.	DATE	APPR.		APPR. <i>OR</i>
			OVERLAY NOTCHING	DWG. NO. 643

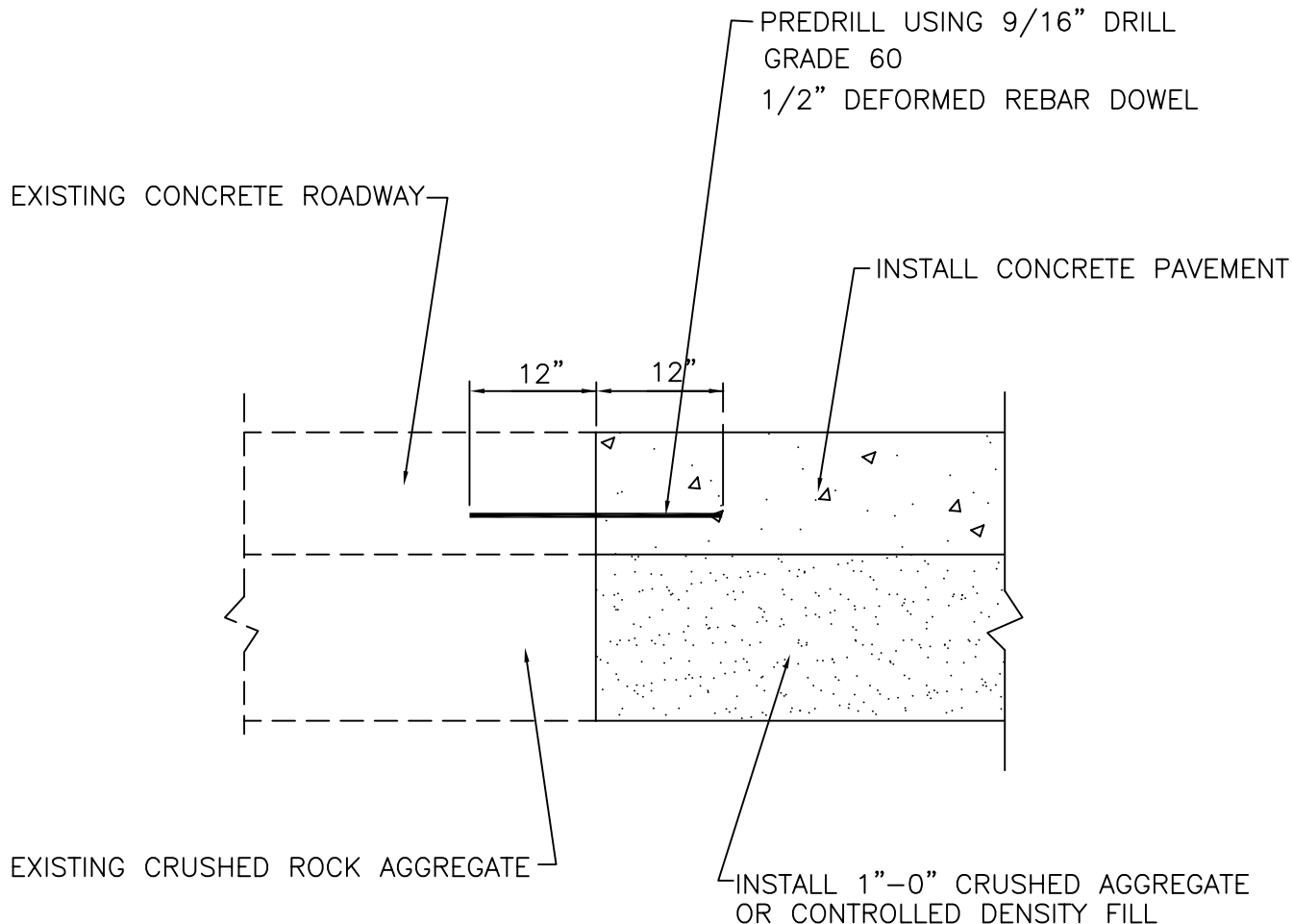


PLAN VIEW




- STEP 1** COVER EXISTING MANHOLE WITH BUILDING PAPER AND CONSTRUCT A/C PAVEMENT OVER TOP OF MANHOLE.
- STEP 2** SAW CUT AND REMOVE PAVEMENT AROUND MANHOLE 12" MIN. FROM MANHOLE FRAME.
- STEP 3** RAISE OR LOWER MANHOLE FRAME AND IF NECESSARY INSTALL CONCRETE RINGS TO FINISH PAVEMENT PROFILE AND CROSS SLOPE.
- STEP 4** WHERE APPLICABLE, BACKFILL WITH 5000 PSI EARLY STRENGTH P.C.C. AND A/C TO DEPTHS AS DIRECTED.

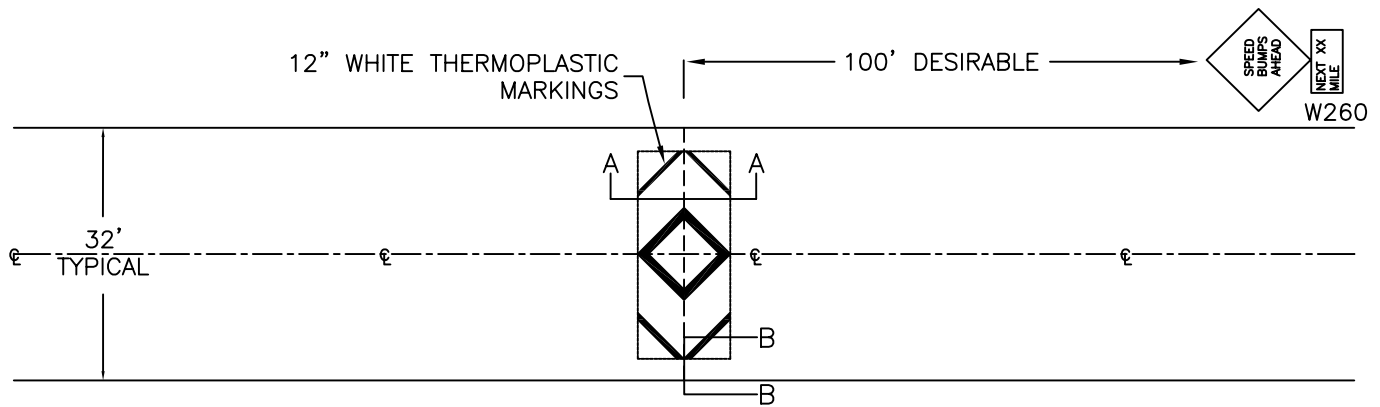
DRAWN			TA	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030			SCALE		N.T.S.		
DIV.			TRANSPORTATION				DATE		JAN. 1, 2006		
REV.	DATE	APPR.	APPR.								
					MANHOLE FRAME ADJUSTMENT DETAIL			DWG. NO.		644	



NOTES:

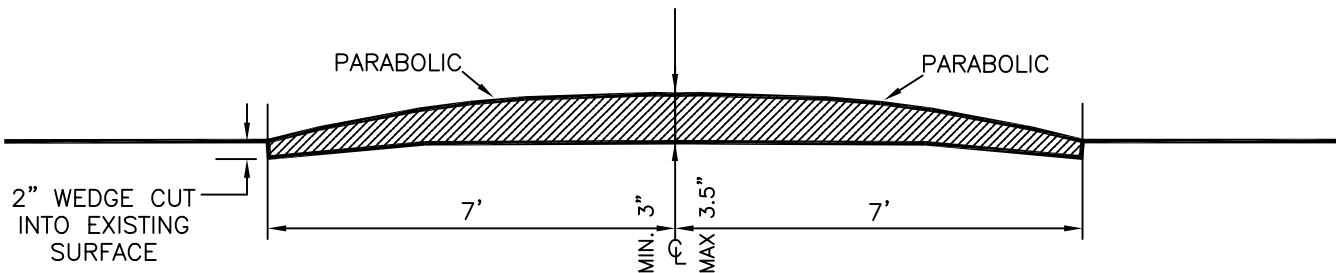
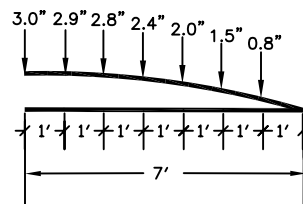
1. EXISTING SLAB SHALL BE DRILLED USING APPROPREATE MASONARY DRILL BIT (ROTO HAMMER WILL NOT BE ALLOWED)
2. DOWELS SHALL BE PLACED AT 24" O.C.

DRAWN TA			DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030	N.T.S.	
DIV. TRANSP.				DATE JAN. 1, 2006	
REV.	DATE	APPR.		APPR. 	
			PCC TRENCH RESTORATION DETAIL	DWG. NO. 645	

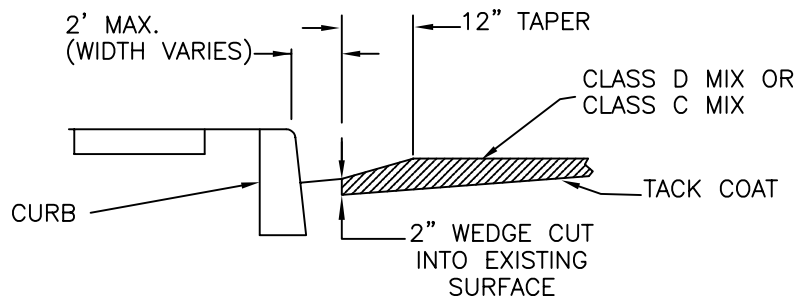


SIGNING AND STRIPING PLAN

SIGNS TO BE INSTALLED BY OTHERS



SECTION A-A

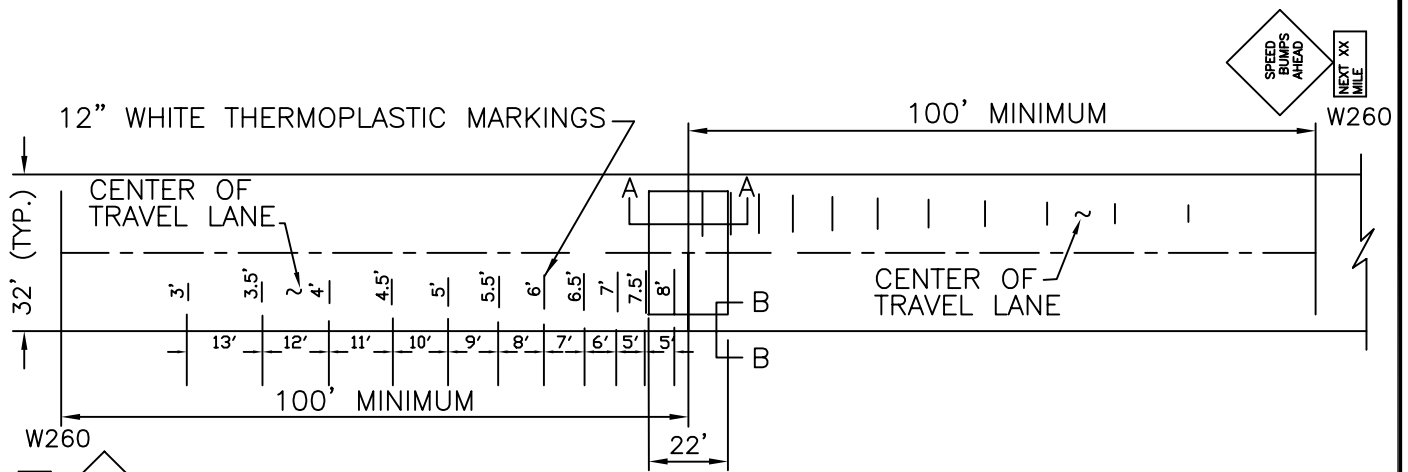


SECTION B-B

NOTES:

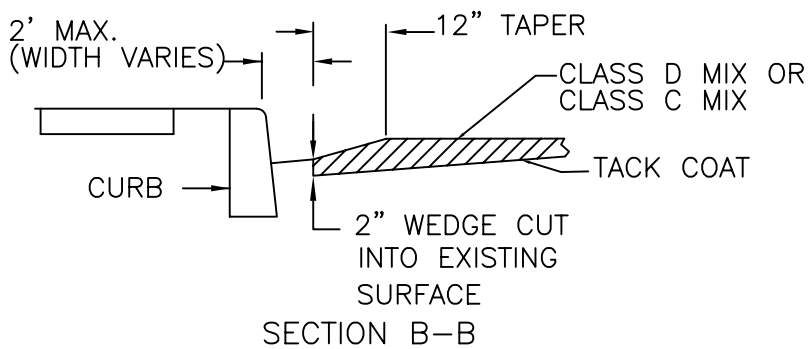
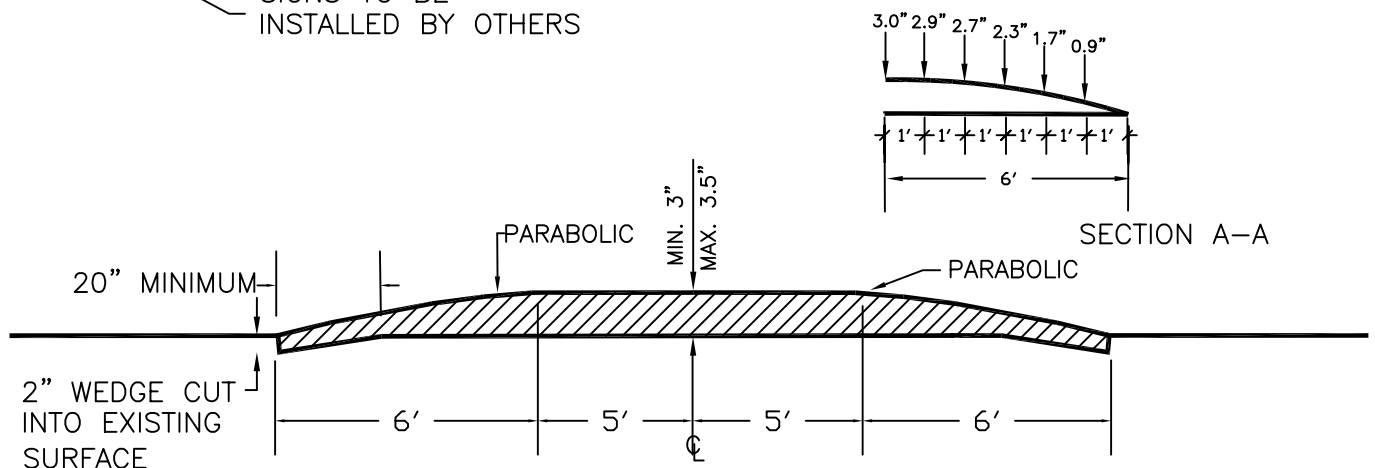
1. SPACING - SPEED HUMPS SHOULD BE PLACED ACCORDING TO THE ENGINEER'S EVALUATION OF THE PHYSICAL STREET SECTION AS WELL AS TRAFFIC OPERATIONS DATA. TYPICALLY, SPEED HUMPS SHOULD BE PLACED BETWEEN 300 AND 600 FEET APART.
2. TOLERANCE - THE TOLERANCE FOR SPEED HUMPS SHOULDN'T VARY BY MORE THAN .5" HIGH OR .25" LOW FROM THE CITY'S TEMPLATE.

DRAWN	MRM	DEPARTMENT OF ENVIRONMENTAL SERVICES CITY OF GRESHAM 1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		SCALE	N.T.S.
DIV.	TRANSPORTATION			DATE	JAN. 1, 2006
REV.	DATE			APPR.	<i>[Signature]</i>
				DWG. NO.	646



SIGNING AND STRIPING PLAN

SIGNS TO BE
INSTALLED BY OTHERS



NOTES:

1. SPACING - SPEED HUMPS SHOULD BE PLACED ACCORDING TO THE ENGINEER'S EVALUATION OF THE PHYSICAL STREET SECTION AS WELL AS TRAFFIC OPERATIONS DATA. TYPICALLY, SPEED HUMPS SHOULD BE PLACED BETWEEN 300 AND 600 FEET APART.
2. TOLERANCE - THE TOLERANCE FOR SPEED HUMPS SHOULDN'T VARY BY MORE THAN .5" HIGH OR .25" LOW FROM THE CITY'S TEMPLATE.

DRAWN	MRM	DEPARTMENT OF ENVIRONMENTAL SERVICES		SCALE N.T.S.	
DIV. TRANSPORTATION				DATE JAN. 1, 2006	
REV.	DATE	APPR.	CITY OF GRESHAM		APPR. <i>[Signature]</i>
			1333 N.W. EASTMAN PARKWAY, GRESHAM, OREGON 97030		DWG. NO. 647
			22 FT. WIDE SPEED HUMP		

PUBLIC WORKS STANDARDS

CONSTRUCTION STANDARD SPECIFICATIONS

Unless specified otherwise in the Contract Documents, the *Public Works Standards* apply in their entirety to all City of Gresham Department of Environmental Services publicly financed public improvement contracts. In addition, the *Public Works Standards*, except where noted, apply to all privately financed, public improvement projects that will be accepted for ownership and operation by the City of Gresham.

DEPARTMENT OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM, OREGON

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**101 DEFINITIONS, ABBREVIATIONS, AND
PRIVATELY FINANCED PUBLIC IMPROVEMENT REQUIREMENTS**

The definitions provided by ORS Chapters 279A and 279C and OAR Chapter 137 Divisions 46 and 49 apply to all projects that incorporate the *Public Works Standards* of the City of Gresham into the Contract Documents of a project. Unless otherwise defined by applicable law or the Contract Documents, the following definitions and abbreviations shall apply whenever used.

The words directed, required, permitted, ordered, requested, instructed, designated, considered necessary, prescribed, approved, acceptable, satisfactory, or words of like meaning, refer to actions, expressions, and prerogatives of the City.

Command type sentences are used but are not exclusive of other directives, throughout these Standard Specifications. In all cases the command expressed or implied is directed to the Contractor.

The Standard Specifications contained herein are divided into categories: (1) Division; (2) Section; and (3) Subsection, and are designated as in the following example:

- (1) Division: ***DIVISION TWO – GENERAL TECHNICAL REQUIREMENTS***
- (2) Section: ***204 EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL***
- (3) Subsection: ***204.02.05 Select Backfill Material***
or
204.02.05A Crushed Aggregate

In Division I – General Requirements, paragraphs under subsections are alphabetical with subparagraphs numbered (1), (2), etc.

101.01 DEFINITIONS

Attorney

The City Attorney of the City of Gresham, Oregon.

Bidder

An entity that submits an Offer in response to a Notice to Contractors.

Certificate of Compliance

Standard City form that must be signed by the Contractor stating compliance with the Contract.

Certificate of Final Completion

Standard City form that is signed by the Manager when the Work has been 100% completed in accordance with all requirements.

Certificate of Substantial Completion

Standard City form that is signed by the Project Manager when the Work (or a specified part thereof) has progressed to the point where, in the opinion of the Project Manager, it is sufficiently complete in accordance with the Contract, so that the Work (or specified part) can be utilized for the purposes for which it is intended.

Change Order

A written order issued by the Project Manager to the Contractor directing changes in the Work, subject to approval of the Manager.

City

The City of Gresham, a municipal corporation of the State of Oregon, and its elected officials, officers, employees, volunteers and agents.

Contract

The written agreement, resulting from the Notice to Contractors and Offer that sets forth the rights and obligations of the City and the Contractor.

Contract Documents

For publicly financed public improvement projects, Parts I, II, III, IV, V, VI and VII of the materials provided to Bidders and includes all documents included or referenced therein, the Contract, any addendums issued before Offers are opened, and any amendments or Change Orders after the Contract is signed.

For privately financed public improvements projects, the Contract Documents include but are not limited to the *Public Works Standards*, the applicable development permit(s) including any conditions of approval, and the approved Plans for the Work.

Contract Item

A specific unit of work for which a price or basis of payment is provided in the Contract.

Contract Price

The total price to be paid for the Work, including any approved alternates and any fully executed Change Orders or amendments.

Contractor

For publicly financed public improvement projects, “contractor” will mean the entity awarded the Contract. For privately financed public improvement projects, “contractor” will mean the development permit holder.

Days

Calendar days unless otherwise specified in the Contract Documents.

Engineer

The applicable City of Gresham Department of Environmental Services division manager, or designee, who is licensed as a registered professional engineer in the State of Oregon.

Engineer of Record

A registered professional engineer licensed to practice in the State of Oregon who is responsible for the design of a public improvement and who has stamped the Plans.

Foreign Contractor

A Contractor who is not domiciled in or registered to do business in the State of Oregon.

Improvement

General term encompassing all phases of Work to be performed under the Contract Documents and synonymous with the term Project.

Inspector

The authorized representative of the City whose authority, instructions, and decisions shall be limited to the particular duties and responsibilities entrusted to them in making detailed inspections of any or all portions of the Work or materials thereof.

Lump Sum

A method of payment providing for one all-inclusive payment for the Work described to be done, complete and accepted without further measurement, as such Work is covered under the applicable Lump Sum pay item.

Manager

The City Manager of the City of Gresham acting either directly or through authorized representatives.

Notice

A written communication delivered by hand or by mail to the authorized individual, member of the firm, or officer of the corporation for which it is intended. If delivered or sent by mail it shall be addressed to the last known business address of the individual, firm, or corporation. In the case of a Contract with two (2) or more persons, firms, or corporations, notice to one shall be deemed notice to all.

Notice to Contractors

The public announcement inviting Offers for Work to be performed or materials to be furnished.

ODOT/APWA Standard Specification for Construction

The latest edition of the specification document published by the Oregon Department of Transportation and the American Public Works Association entitled Standard Specifications for Construction. This document is available from the Oregon Department of Transportation, Salem, Oregon.

Offer

A competitive Offer, binding on Bidder and submitted in response to a Notice to Contractors.

One-Stage Construction

When asphaltic concrete pavement is constructed so as not to allow general vehicular traffic to use the asphaltic surface prior to the final lift being placed.

Ownership and Operation Form

Standard City form for privately financed public improvements that are signed by the Manager when the Work has been completed in accordance with all requirements.

Plans

The Standard Details, or reproductions thereof, and project specific Plans, profiles, cross sections, elevations, details, and other working or supplementary drawings signed by the Engineer of Record that show the location, character, dimensions, and details of the Work to be performed. Plans for privately financed public improvement projects must be approved by the Project Manager. Plans for publicly financed public improvement projects may either be bound in the same book as the balance of the Contract Documents or bound in separate sets and are a part of the Contract Documents regardless of the method of binding.

Project

General term encompassing all phases of the Work to be performed under the Contract Documents and synonymous with the term Improvement.

Project Manager

The City's representative charged with the management of the Project. For publicly financed public improvement projects, the Project Manager is typically the Engineer or the Engineer's representative. For privately financed public improvement projects, the Project Manager is typically a Development Engineering Specialist of the City.

Provide

When related to an item of work, the word "provide" shall be understood to mean furnish and install the Work complete in place.

Public Works Standards

The *Public Works Standards* adopted by the City of Gresham and containing Design Standards, Construction Standard Specifications, and Standard Details.

Reference Specifications

Bulletins, standards, rules, methods of analysis or test, codes and specifications of other agencies, engineering societies, or industrial associations referred to in the Contract Documents. All such references specified herein refer to the latest edition thereof, including any amendments, updates, or new editions thereto that are in effect and published at the time of the Notice to Contractors for a publicly financed public improvements or date of development application for privately financed public improvements.

Right-of-way

A general term denoting public land, property, or interest therein, acquired for or devoted to a public street or accessway.

Roadway

That portion of a street and its appurtenances, typically between curbs or ditches, primarily used for vehicular traffic.

Shop Drawings and Submittals

Supplementary Plans or data or other information that the Contract Documents require the Contractor to submit to the Project Manager.

Shown

As used herein, the word “shown,” or “as shown,” shall be understood to refer to work shown on the Plans in the Contract Documents.

Special Provisions

Project specific requirements that make changes, modifications, or clarifications to the Standard Specifications

Special Specifications

Project specific technical requirements that supplement Divisions Two through Six of the *Public Works Standards*.

Specifications

The Standards Specifications, Special Provisions and Special Specifications referred to or set forth in the Contract Documents.

Specified

As used herein, the word “specified,” or “as specified,” means as required by the Contract Documents.

Standard Details or Standard Detail Drawings

Detailed representations of structures, devices, or instructions set forth in the *Public Works Standards*.

Standard Specifications

The terms, directions, provisions and requirements set forth in Divisions One through Six of the *Public Works Standards*.

Station

A distance measured horizontally along the established centerline of a street, sewer, or other work, unless specified otherwise.

Street

Any street, avenue, boulevard, alley, lane, bridge, bicycle path, road, public thoroughfare or public way, and any land over which a Right-of-way has been obtained or granted for any purpose of public travel.

Subcontractor

An individual, partnership, firm, corporation, or any combination thereof, which the Contractor has selected to perform part of the Work.

Surety

The corporate body that is bound with and for the Contractor for the acceptable performance of the Project and for the payment of all obligations arising out of the Contract Documents.

Two-Stage Construction

When traffic is allowed to use the asphaltic surface constructed as a portion of the Project prior to the final lift of asphaltic concrete pavement being placed.

Unit Price

A Contract Item of work providing for payment based on a specific unit of measurement; e.g., lineal foot or cubic yard.

Use of Pronoun

As used herein, the singular shall include the plural, and the plural the singular; any masculine pronoun shall include the feminine or neuter gender; and the term "person" includes natural person or persons, firm, co-partnership, corporation or association, or combination thereof.

Utility

Tracks, overhead or underground wires, pipelines, conduits, ducts, or structures, owned, operated, or maintained in or across a public Right-of-way or easement.

Work

The furnishing of all materials, equipment, labor, and incidentals necessary to successfully complete any individual item or, if the context requires, the entire Project including the successful completion of all duties and obligations imposed by the Contract Documents.

Working Day

Calendar day, any and every day shown on the calendar, excluding Saturdays, Sundays, and legal holidays.

101.02 ABBREVIATIONS

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforced Steel Institute
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
GCDP	Gresham Community Development Plan, Vol. III
GRC	Gresham Revised Code
ITE	Institute of Traffic Engineers
MUTCD	Manual of Uniform Traffic Control Devices
NEC	National Electrical Code
ODOT	Oregon Department of Transportation
ORS	Oregon Revised Statutes
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.
USASI	United States of America Standards Institute

101.03 *APPLICABILITY OF PUBLIC WORKS STANDARDS TO PRIVATELY FINANCED PUBLIC IMPROVEMENTS*

A. The *Public Works Standards* are applicable to all public improvements constructed within the City of Gresham, including public improvements built in conjunction with private development.

B. The *Public Works Standards* contains provisions relating to offers and contracts let by the City for publicly financed public improvement projects. These provisions are not applicable to privately financed public improvement projects. The remaining provisions of the Standards are applicable to privately financed public improvement projects.

C. If a section or subsection of the *Public Works Standards* is not applicable in its entirety to privately financed public improvements, it is so noted in the title of the section or subsection. If not noted in the title as (“Not applicable to privately financed public improvements”), the section or subsection is applicable to privately financed public improvements except as specifically stated in the subsection.

101.04 *QUALIFICATION OF CONTRACTORS*

A. A person shall not construct privately financed public improvements unless the person has met the standards of responsibility as provided by ORS 279C.375(2)(b).

B. A Contractor’s Qualification Application must be submitted prior to issuance of a Notice to Proceed. Qualification application forms may be obtained from the Project Manager. In lieu of an application, submit proof that Contractor has been found qualified by the City for the same kind of work and that such qualification has not lapsed.

C. If a person intends to rely on a subcontractor’s qualification, submit the subcontractor’s qualification application or proof that the subcontractor has previously been qualified for the same kind of work.

101.05 *NOTICE TO PROCEED; COMPLIANCE WITH OTHER PROVISIONS*

A. No construction work on privately financed public improvement projects may commence until the Project Manager issues a Notice to Proceed.

B. A Notice to Proceed for privately financed public improvement projects shall not be issued unless the subject development, and any other development of the developer within the City of Gresham, is in substantial compliance with all applicable federal, state, and local laws, rules, regulations, permits, and the Contractor Documents relating to such developments. If there is a material violation of any such requirement, the City may elect to withhold the Notice to Proceed for privately financed public improvement projects until such time as the violation has been resolved to the satisfaction of the City.

101.06 *GUARANTEE OF COMPLETION AND WARRANTY GUARANTEE FOR PRIVATELY FINANCED PUBLIC IMPROVEMENTS*

Prior to issuance of the Notice to Proceed for privately financed public improvement projects, the developer shall furnish a Guarantee of Completion approved by the Manager and Attorney in an amount equal to 110% of the estimated plan check, administration, inspection, and construction costs of the privately financed public improvement. The estimated costs shall be determined by the Engineer of Record’s estimate, the tabulation of bids, or other method acceptable to the Project Manager. The Guarantee of Completion shall be conditioned upon compliance with and fulfillment of all terms and provisions of the Gresham Community Development Code, Gresham Revised Code, the Contract Documents, and any agreement relating to the construction of the public improvements.

A Warranty Guarantee pursuant to GCDP A5.004 shall be required before the City accepts the work for ownership and operation.

101.07 *COMPLETION OF PRIVATELY FINANCED PUBLIC IMPROVEMENTS*

A. Privately financed public improvement projects shall be completed within two years of the issuance of the Notice to Proceed unless the City extends the completion date. The Project Manager may require additional bonding and impose other conditions before granting such an extension.

B. When the improvements are sufficiently complete, as determined by the Project Manager, the City will inspect the improvements and create a list of any deficient items. These items must be rectified prior to the City's acceptance of the public improvements.

C. Privately financed public improvements shall not be accepted by the City for ownership and operation until all requirements of the Contract Documents have been completed to the satisfaction of the City, and all fees and charges have been paid.

102 INSTRUCTIONS TO BIDDERS

(Not applicable to privately financed public improvements)

The provisions of Oregon Revised Statutes Chapter 279A and 279C and Oregon Administrative Rules Chapter 137, Divisions 46 and 49, apply to all publicly financed public improvement projects that incorporate the *Public Works Standards* of the City of Gresham into the Contract. The ORS and OAR provisions control over any conflicting language in the *Public Works Standards*.

102.01 SOLICITATION

A person may protest or request a change of a solicitation provision, evaluation criteria, plan, specification, or contract term no later than ten calendar days prior to the offer due date. No protest of the selection of a contractor or the award of a contract because of a solicitation provision, evaluation criteria, plan, specification, or contract term will be considered after such time. The protest or request for change shall include the reason for such and any proposed change. The Manager shall consider the protest or request for change and may reject the protest or request for change, issue an addendum, or cancel the Notice to Contractors. The protest must be submitted to the Project Manager.

102.02 BID PROVISIONS

1. No offer will be received or considered by the City unless the offer contains a statement by the Bidder as a part of its offer that the provisions of ORS 279C.840 are to be complied with. The existing prevailing rate of wage in the form of a Bureau of Labor and Industries (BOLI) document is included in the Contract Documents. A fee is required to be paid to the Commissioner of BOLI as provided in ORS 279C.825.

2. Each Bidder must identify in the offer whether the Bidder is a "resident bidder" as defined in ORS 279A.120.

3. The Bidder need not be licensed under ORS 468A.720 relating to asbestos abatement unless otherwise noted in the Special Provisions.

4. No offer for a construction contract shall be received or considered by the City unless the Bidder is licensed with the Construction Contractors Board. In the case of work to be performed by a landscape contractor, the Bidder must be licensed with the State Landscape Contractors Board.

5. Instructions for First-Tier Subcontractors Disclosure

Bidders are required to disclose information about certain first-tier subcontractors when the contract value for a public improvement is greater than \$100,000 (see ORS 279C.370).

Specifically, when the contract amount of a first-tier subcontractor furnishing labor or labor and materials would be greater than or equal to (i) 5% of the project bid, but a least \$15,000, or (ii) \$350,000 regardless of the percentage, the Bidder must disclose the following information about that subcontract in its bid submission or within two working hours after bid closing:

- 1) The subcontractor's name,
- 2) The dollar value, and
- 3) The category of work that the subcontractor would be performing.

If the Bidder will not be using any subcontractors that are subject to the above disclosure requirements, the Bidder is required to indicate "NONE" on the accompanying form.

THE CITY OF GRESHAM MUST REJECT A BID IF THE BIDDER FAILS TO SUBMIT THE DISCLOSURE FORM WITH THIS INFORMATION BY THE STATED DEADLINE (see OAR 137-49-0360).

102.03 QUALIFICATION OF BIDDERS AND CONTRACTORS

Qualification requirements applicable to privately financed public improvement projects can be found in **Subsection 101.04**.

A. Bidders need not be prequalified unless required by a Special Provision. All prequalification requirements shall be included in the Special Provision.

B. If **Subsection 102.03(A)** does not apply, Bidder's qualifications and responsibility will be reviewed after offer opening when the City determines the lowest responsible Bidder.

C. Each Bidder shall submit a Contractor's Qualification Application with its bid. Qualification application forms may be obtained from the Project Manager. In lieu of an application, Bidders may submit proof that Bidder has been found qualified by the City for the same kind of work and that such qualification has not lapsed prior to offer opening. It is each Bidders sole responsibility to determine if the Bidder is currently qualified by the City for the same kind of work.

D. If the Bidder intends to rely on a subcontractor's qualification, submit with the offer the subcontractor's qualification application or proof that the subcontractor has previously been qualified for the same kind of work.

E. Qualification applications shall be submitted in a separate envelope and a \$100 application fee must accompany each qualification application. The City will process only those applications necessary to determine the lowest responsible bidder. Applications and fees not processed will be returned to the applicant.

102.04 FORM OF BID

A. Bidders shall enclose the offer, any documents required to be submitted with the offer, and a bid bond, certified check or cashier's check in a sealed, labeled, and addressed envelope and submit the envelope as required in the Notice to Contractors. The outside of the envelope should plainly identify the Project name and the offer opening date and time. Facsimile and electronic data interchange offers shall not be accepted unless otherwise specified in the Special Provisions.

B. All offers must be clearly and distinctly typed or written with ink or indelible pencil and be on the form furnished by the City and, in addition to necessary unit price items and total prices in the column of totals to make a complete bid, all applicable blanks giving general information must be filled in and the offer signed by the Bidder or a duly authorized agent. Any statement accompanying and tending to qualify an offer may cause rejection of such bid, unless such statement is required in an offer embracing alternative bids.

C. Unless otherwise specified, Bidders shall offer on all items included in the Contract Documents, and the low Bidder shall be determined as noted in **Subsection 104.01**. Except as provided herein, offers that are incomplete or fail to reply to all items required in the Contract Documents may be rejected.

D. State whether business is being done as an individual, a co-partnership, a corporation, or a combination thereof, and if incorporated, in what state, and if a co-partnership, state names of all partners. The person signing on behalf of a corporation, a co-partnership, or combination thereof shall state their position with the firm or corporation and state whether the corporation is licensed to do business in the State of Oregon.

102.05 WITHDRAWAL, MODIFICATION, OR ALTERATION OF BID

A. An offer may only be withdrawn on written or electronic request of the Bidder and received by the Project Manager prior to the scheduled closing time for submitting offers.

B. Prior to offer opening, changes may be made provided the Bidder or the Bidder's agent initials the change. If the intent of the Bidder is not clearly identifiable, the interpretation most advantageous to the City will prevail.

C. No Bidder may withdraw an offer after offer opening unless 60-days have elapsed and the City has not awarded a contract.

102.06 LATE OFFERS

Offers received after the scheduled closing time for submission of offers as set forth in the Notice to Contractors will be rejected and returned unopened to the Bidder.

102.07 BID SECURITY

All offers must be accompanied by a Bid Security guaranteeing that the offer will be irrevocable for 60-days, unless specified otherwise, in the form of a certified check or cashier's check payable to the order of the City, or a Bidder's bond in such form as is approved by the Attorney in an amount of at least ten percent (10%) of the amount of the bid. Such bid security shall be forfeited if the Bidder shall fail or neglect to furnish the performance and payment bonds, certificate of insurance, and to execute and return the Contract within fifteen (15) days after issuance of the Contract.

102.08 ADDENDA

A. If, in the opinion of the Project Manager, additional information or interpretation of the Contract Documents is required, an addendum will be issued. Addenda to the Contract Documents shall be mailed to potential Bidders that have obtained a copy of the Contract Documents from the Department of Environmental Services. Addenda shall also be mailed to potential Bidders who have given written notice to the Project Manager listed in the Notice to Contractors of their interest in a particular project.

B. Any addendum issued by the City that may include changes, corrections, additions, interpretations, or information and issued seventy-two (72) hours or more before the scheduled closing time for submission of offers, Saturday, Sunday, and legal holidays not included, shall be binding upon the Bidder.

C. Oral instructions or information concerning the contract or the project given out by officers, employees, or agents of the City to prospective Bidders shall not bind the City.

102.09 EXAMINATION OF THE CONTRACT DOCUMENTS, SITE OF WORK, AND SUBSURFACE DATA

Bidders are advised to review *Subsection 103.26* regarding this matter.

102.10 FAMILIARITY WITH LAWS AND ORDINANCES

Bidders are advised to review *Subsection 103.27* regarding this matter.

102.11 UNIT PRICES

A. The estimate of quantities of work to be done under unit prices is approximate and is given only as a basis of calculation for comparison of offers and award of the Contract. The City does not warrant that the actual amount of work will correspond to the amount as shown or estimated. Payment at unit prices will only be made for work actually performed or materials actually furnished according to actual measurements that were necessary to complete the work.

B. Bidders must include in their unit prices the entire cost of each item of work set forth in the offer, and when, in the opinion of the City, the prices in any offer are obviously unbalanced, such offer may be rejected.

C. The unit prices for the various Contract items shall be full compensation for all labor, materials, supplies, equipment, tools, and all things of whatsoever nature are required for the complete incorporation of the item into the work the same as though the item were to read "In Place."

102.12 REJECTION OF OFFERS

The City may reject any offer not in compliance with all prescribed public bidding procedures and requirements and may, for good cause, reject any or all offers upon a finding it is in the public interest to do so. In any case where competitive offers are required and all offers are rejected and the project is not abandoned, new offers may be called for as in the first instance. The City may, at its own discretion, waive minor informalities.

102.13 CONFLICT OF INTEREST

A Bidder submitting an offer thereby certifies that no officer, agent, or employee of the City who has a pecuniary interest in the offer has participated in the Contract negotiations on the part of the City, that the offer is made in good faith without fraud, collusion, or connection of any kind with any other Bidder, and that the Bidder is competing solely on its own behalf without connection with, or obligation to, any undisclosed person or firm.

102.14 INELIGIBILITY FOR PUBLIC CONTRACTS FOR FAILURE TO PAY PREVAILING RATE OF WAGE

The Bidder, in submitting the bid, certifies that the Bidder is not ineligible to receive a contract for a public work pursuant to ORS 279C.860. Bidder agrees, if awarded a contract, that every subcontractor will not be ineligible to receive a contract for a public work pursuant to ORS 279C.860.

103 LEGAL RELATIONS AND RESPONSIBILITIES

103.01 APPLICABLE LAWS AND VENUE

The provisions of the Contract Documents shall be construed in accordance with the laws of the State of Oregon and ordinances of the City of Gresham, Oregon. Any action or suits involving any question arising under the Contract Documents must be brought in the appropriate court in Multnomah County, Oregon. If the claim must be brought in a federal forum, then it shall be brought and conducted in the United States District Court for the District of Oregon.

103.02 EQUAL EMPLOYMENT OPPORTUNITY/AFFIRMATIVE ACTION

The Contractor must comply with the City of Gresham's Equal Opportunity Policy for Contractors. The Contractor shall not discriminate against minorities, women, or emerging small business enterprises in the awarding of subcontracts.

103.03 ASSIGNMENT OF ANTITRUST RIGHTS CLAIMS *(Not applicable to privately financed public improvements)*

By entering into the Contract, the Contractor, for consideration paid to the Contractor under the Contract, does irrevocably assign to the City any claim for relief or cause of action which the Contractor now has or which may accrue to the Contractor in the future, including, at the City's option, the right to control any such litigation on such claim for relief or cause of action, by reason of any violation of 15 USC 1-15 or ORS 646.725 or ORS 646.730, in connection with any goods or services provided to the Contractor by any person, which goods or services are used, in whole or in part, for the purpose of carrying out the Contractor's obligations under the Contract.

In the event the Contractor hires subcontractors to perform any of the Contractor's duties under the Contract, the Contractor shall require the subcontractor to irrevocably assign to the City, as a third party beneficiary, any right, title, or interest that has accrued or may accrue to the subcontractor by reason of any violation of 15 USC 1-15, ORS 646.725 or ORS 646.730, including, at the City's option, the rights to control any litigation arising thereunder, in connection with any goods or services provided to the subcontractor by any person, in whole or in part, for the purpose of carrying out the subcontractor's obligations as agreed to by the Contractor in pursuance of the completion of the Contract.

In connection with this assignment, it is an express obligation of the Contractor that it will take no action that will in any way diminish the value of the rights conveyed or assigned hereunder to the City. It is an express obligation of the Contractor to advise the Attorney:

A. In advance, of its intention to commence any action on its own behalf regarding such claims for relief or causes of action; **and**

B. Immediately, upon becoming aware of the fact that an action has been commenced on its own behalf by some other person(s), of the pendency of such action; **and**

C. The date on which it notified the obligor(s) of any such claims for relief or causes of action of the fact of its assignment to the City.

Furthermore, it is understood or agreed that in the event that any payment under any such claim is made to the Contractor, it shall promptly pay over to the City its proportionate share thereof, if any, assigned to the City hereunder.

103.04 SUBCONTRACTORS

A. Use of subcontractors, material suppliers, or equipment suppliers shall in no way release the Contractor from any obligations to the City.

B. The Contractor will provide in all subcontract agreements that the subcontractor, material supplier, and equipment supplier will be bound by the terms and conditions of the Contract Documents to the extent that they relate to the subcontractor's work, material, or equipment. For publicly financed public improvement projects, subcontracts are assignable to the City at the City's option, in the event the Contract is terminated for default of the Contractor.

C. For publicly financed public improvements projects the Contractor will require each subcontractor providing labor for the project to:

1. Demonstrate to the Contractor that it has a Qualifying Employee Drug-testing Program (See Subsection 104.02.B) for the subcontractor's Subject Employees. Subcontractors shall represent and warrant to the Contractor that the Qualifying Employee Drug-testing Program is in place at the time of subcontract execution and will continue in full force and effect for the duration of the subcontract; or

2. Require that the subcontractor's Subject Employees participate in the Contractor's Qualifying Employee Drug-testing Program for the duration of the subcontract.

103.05 NO WAIVER OF LEGAL RIGHTS *(Not applicable to privately financed public improvements)*

The City shall not be precluded or estopped by any measurement, estimate, or certificate made either before or after completion and acceptance of work or payment therefore, from showing the true amount and character of work performed and materials furnished by the Contractor, or from showing that any such measurement, estimate, or certificate is untrue or incorrectly made, or that work or materials do not conform to the Contract Documents. The City shall not be precluded or estopped, notwithstanding any such measurement, estimate, or certificate, or payment in accordance therewith, from recovering from the Contractor and the surety such damages as it may sustain by reason of failure to comply with terms of the Contract Documents, or from enforcing compliance with the Contract Documents. Neither acceptance by the City, or by any representative or agent of the City, of the whole or any part of the work, nor any extension of time, nor any possession taken by the City, nor any payment for all or any part of the project, shall operate as a waiver of any portion of the Contract Documents or of any power herein reserved, or any right to damages herein provided. A waiver of any breach of the Contract shall not be held to be a waiver of any other breach.

103.06 OTHER CONTRACTS

A. The City reserves the right to award other contracts or issue permits for work that may require coordination with the work to be performed under the Contract Documents.

B. When other contracts or permits are awarded or issued for different portions of the work, "the contractor" in each case shall be the person who signs the other contract or is the holder of the permit.

C. Mutual Responsibility of Contractors – The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall properly connect and coordinate said work with theirs.

D. If any part of the Contractor's work depends, for proper execution or results, upon the work of any other contractor, the Contractor shall inspect and promptly report to the Project Manager any apparent discrepancies or defects in such work that render it unsuitable for such proper execution and results. Failure of the Contractor to inspect and report shall constitute an acceptance of the other contractor's work as fit proper to receive the work, except as to defects that may develop in the other contractor's work after the execution of the Contractor's work.

E. Should the Contractor cause damage to the work or property of any other contractor which results in a claim against the City, and if the claim is not satisfied by the Contractor and the other contractor sues the City or initiates an arbitration proceeding on account of any damage alleged to have been so sustained, the City shall notify the Contractor who shall defend if requested such proceedings at the Contractor's expense, and if there is any judgment or award against the City, the Contractor shall pay or satisfy it and shall reimburse the City for all attorney's fees and court or arbitration costs which the City has incurred.

F. The Contractor shall be responsible for any cutting, fitting, and patching that may be required to complete the work except as otherwise specifically provided in the Contract Documents. The Contractor shall not endanger any work of any other contractors by cutting, excavating or otherwise altering any work and shall not cut or alter the work of any other contractor. Any costs caused by defective or ill-timed work shall be borne by the party responsible therefore.

G. If a dispute arises as to the responsibility for cleaning up or finishing work, the City may clean up and charge the cost thereof to the Contractor and other contractors as the Project Manager shall determine to be just.

103.07 LIABILITY AND INDEMNIFICATION

The Contractor shall assume all responsibility for the work and shall bear all losses and damages directly or indirectly resulting to the Contractor or to the City, on account of (a) the character or performance of the work, (b) unforeseen difficulties, (c) accidents, or (d) any other cause whatsoever.

Contractor shall defend, save, hold harmless, and indemnify the City, the Engineer of Record, and their officers, agents, and employees from all claims, suit, or actions of whatsoever nature resulting from arising out of the

activities of the Contractor or its officers, employees, subcontractors, or agents under the Contract Documents. The Contractor shall assume this responsibility even if (a) fault is the basis of the claim, or (b) any act, omission or conduct of the City is a condition or contributory cause of the claim, loss, damage or injury. The Contractor waives any and all statutory or common law rights of defense and indemnification by the City.

The Contractor shall not be liable for, nor be required to defend or indemnify the City or the Engineer of Record relative to any claim, loss, damage, or injury resulting solely from acts or omissions by the City, the Engineer of Record, or their officers, agents or employees.

Any specific duty or liability imposed or assumed by the Contractor as may be otherwise set forth in the Contract Documents shall not be construed as a limitation or restriction of the general liability or duty imposed upon the Contractor by this subsection.

103.08 INSURANCE *(Not applicable to privately financed public improvements)*

A. General

1. The Contractor shall provide and maintain during the life of the Contract the insurance coverage described below. All costs for such insurance shall be borne by the Contractor at no expense to the City.

2. In case of the breach of any provision of this subsection, the City may elect to take out and maintain, at the expense of the Contractor, such insurance as the City may deem proper. The City may deduct the cost of such insurance from any monies that may be due or become due the Contractor under the Contract. Failure to maintain insurance as provided is also cause for immediate termination of the Contract.

B. Review and Approval of Insurance

Contractor shall furnish the Project Manager certificates of insurance, which must be acceptable to the Attorney prior to execution of the Contract by the City and before the Contractor or any subcontractor commences work under the Contract. The certificate shall show the name of the insurance carrier, coverage, type, amount (or limits), policy numbers, effective and expiration dates, and a description of operations covered. The certificate will include the deductible or retention level and required endorsements. Insuring companies or entities are subject to the Attorney's acceptance. If requested, copies of insurance policies shall be provided to the Attorney. The Contractor shall be responsible for all deductibles, self-insured retention's, and/or self-insurance. Approval of the insurance shall not relieve or decrease the liability of the Contractor hereunder.

C. Workers' Compensation

1. The Contractor shall provide and shall require all subcontractors to provide workers' compensation insurance in compliance with ORS 656.017. All employers, including the Contractor, that employ subject workers who work under the Contract in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. The Contractor shall ensure that each of its subcontractors complies with these requirements.

In addition to the statutory benefits outlined above, the Contractor and all subcontractors shall provide employers' liability insurance with limits of not less than:

\$100,000 each accident for bodily injury by accident
\$100,000 each employee for bodily injury for disease
\$500,000 policy limit for bodily injury by disease

2. The Contractor shall defend, indemnify, and hold harmless, the City and the City's officers, agents, and employees against any liability that may be imposed upon them by reason of the Contractor's or subcontractor's failure to provide workers' compensation and employers liability coverage.

3. Where work under the Contract is subject to the Federal Longshoremen's and Harborworkers' Act or the Federal Jones Act, the Contractor shall provide such coverage.

D. General Liability and Automobile Liability for Publicly Financed Public Improvement Projects

1. The Contractor shall provide a commercial general liability policy that provides coverage for bodily injury, personal injury and property damage and commercial automobile liability insurance. Such insurance must protect the Contractor, the City, and their officers and employees from all things or damage which may arise out of the Contract or in connection therewith, including all operations of Subcontractors.

Such insurance shall provide coverage for not less than the following limits of liability:

\$1,000,000	each occurrence
\$1,000,000	general aggregate
\$1,000,000	product and completed operations aggregate
\$50,000	fire damage (any one fire)
\$500,000	employers liability
\$1,000,000	combined single limit automobile liability for owned, non-owned, and hired automobiles. "Symbol One" coverage shall be designated

The policy shall provide that any aggregate applies separately to the Contract. This coverage shall be by endorsement physically attached to the certificate of insurance.

The insurance shall be written on a form that includes coverage for broad form contractual liability; broad form property damage; personal and advertising injury; the owners and contractor protective; premises/operations; and products/completed operations. Coverage shall not exclude excavation, collapse, underground, or explosion hazards. Such insurance shall be maintained until the expiration of the warranty period required by the Contract.

2. The Contractor shall provide a letter from the insurance company that states that such insurance shall be without prejudice to coverage otherwise existing.

3. If there are insufficient insurance proceeds and assets of the Contractor to fully indemnify the City, and the Engineer of Record if not an employee of the City, then the City will be indemnified first with any remaining insurance proceeds and assets to be used to indemnify the Engineer of Record if not an employee of the City.

4. If set forth in a Special Provision, additional insured's may be the City's consultant, the Engineer of Record (if not an employee of the City), other governmental bodies with jurisdiction in the area involved in the project, and their officers and employees and such agents as may be specified.

E. Claims on Project

The Contractor, when notified of a claim by an affected party, shall:

Refer claim to the Contractor's insurance carrier or claims administrator.

The Contractor's insurer will copy the Project Manager on acknowledgment of claim.

The Contractor's insurer will copy the Project Manager on notice to claimant of disposition of claim.

F. Builders Risk Insurance

If required by a Special Provision, the Contractor shall obtain and maintain for the benefit of the parties to the Contract, as their interest may appear, all-risk Builder's Risk insurance to the extent of 100 percent of the value of the project. Coverage shall also include: (1) formwork in place; (2) form lumber on site; (3) temporary structures; (4) equipment; and (5) supplies related to the work while at the site. In the event the Contractor fails to maintain such insurance, the City may arrange for such insurance and any premium incurred shall be at the expense of the Contractor.

G. Notice of Cancellation or Change

There shall be no cancellation, material change, reduction of limits or intent not to renew the insurance coverage(s) without 30 days written notice from the Contractor or its insurer(s) to the Project Manager. This notice provision shall be by endorsement physically attached to the certificate of insurance.

H. Additional Insured

For general liability insurance and automobile liability insurance, the City, its agents, officers, and employees will be Additional Insured's by endorsement, but only with respect to the Contractor's services to be provided under the Contract. This coverage shall be by endorsement physically attached to the certificate of insurance.

103.09 ROYALTIES AND PATENTS

Pay all royalties and license fees required to perform the work. Defend and indemnify the City from all loss or damage that may result from the Contractor's wrongful or unauthorized use of any patented article or process.

103.10 PERMITS

Secure all Municipal, County, State, Federal or other permits or licenses, necessary or incidental to performance of the work under the Contract Documents. Comply with all permit requirements pertaining to the project.

103.11 SANITARY FACILITIES AT CONSTRUCTION PROJECTS

Contractors shall comply with 29 CFR 1926.51 as adopted by OR-OSHS by reference in OAR 437-003-0001(4)(b). In addition, and as required by ORS 654.150, if the Contract price is estimated (unit prices) or offered (lump sum) by the Contractor at \$1,000,000 or more, the Contractor shall be responsible for all costs (which costs shall be included in the offer whether or not a specific item is provided therefore) that may be incurred in complying with or securing exemption or partial exemption from the requirements of ORS 654.150 (Sanitary facilities at construction projects; standards, exemptions) and the rules adopted pursuant thereto. Determination of applicability of ORS 654.150 to the project is the sole responsibility of the Contractor.

The aforementioned requirements notwithstanding, the Contractor shall provide 1 toilet facility for 20 or less employees or, if the Contractor has between 20 and 199 employees, 1 toilet facility per 40 employees shall be provided in accordance with OR-OSHA requirements.

103.12 COMPLIANCE WITH OREGON REVISED STATUTES CHAPTERS 279A and 279C (Not applicable to privately financed public improvements)

Compliance with Applicable Law

Contractor shall comply with all federal, state, and local laws, regulations, executive orders and ordinances applicable to the work under the Contract, including without limitation, ORS 279A.120, ORS 279C.505, ORS 279C.510, ORS 279C.515, ORS 279C.520, ORS 279C.530, ORS 279C.570, and ORS 279C.580, as set forth on Exhibit B. In addition, the provisions of ORS 279C.525 (Provisions concerning environmental and natural resources laws); ORS 279C.540 (Maximum hours of labor on public contracts); ORS 279C.545 (Claims for overtime); ORS 279C.550 to ORS 279C.565 (Retainage); ORS 279C.585 (Authority to substitute undisclosed first-tier subcontractor); ORS 279C.590 (Complaint process for substitutions of subcontractors); ORS 279C.600 to ORS 279C.625 (Bonds); ORS 279C.650 to ORS 279C.670; (Termination for Public Interest) and ORS 279C.800 to ORS 279C.870 (Prevailing Wages) are all incorporated into the Contract by this reference as though set forth in full. Without limiting the foregoing, Contractor expressly agrees to comply with: (i) Titles VI and VII of the Civil Rights Act of 1964, as amended; (ii) Sections 503 and 504 of the Rehabilitation Act of 1973, as amended; (iii) the Americans with Disabilities Act of 1990, as amended; (iv) Executive Order 11246, as amended; (v) the Health Insurance Portability and Accountability Act of 1996; (vi) the Age Discrimination in Employment Act of 1967, as

amended, and the Age Discrimination Act of 1975, as amended; (vii) the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended; (viii) ORS Chapter 659, as amended; (ix) all regulations and administrative rules established pursuant to the foregoing laws; and (x) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations. A condition or clause required by law to be in the Contract shall be considered included by these references.

REQUIRED STATUTORY PROVISIONS

ORS 279C.505 Conditions concerning payment, contributions, liens, withholding, drug testing.

(1) Every public improvement contract shall contain a condition that the contractor shall:

(a) Make payment promptly, as due, to all persons supplying to the contractor labor or material for the performance of the work provided for in the contract.

(b) Pay all contributions or amounts due the Industrial Accident Fund from the contractor or subcontractor incurred in the performance of the contract.

(c) Not permit any lien or claim to be filed or prosecuted against the state or a county, school district, municipality, municipal corporation or subdivision thereof, on account of any labor or material furnished.

(d) Pay to the Department of Revenue all sums withheld from employees under ORS 316.167.

(2) In addition to the conditions specified in subsection (1) of this section, every public improvement contract shall contain a condition that the contractor shall demonstrate that an employee drug-testing program is in place.

ORS 279C.510 Demolition contracts to require material salvage; lawn and landscape maintenance contracts to require composting or mulching.

(1) Every public improvement contract for demolition shall contain a condition requiring the contractor to salvage or recycle construction and demolition debris, if feasible and cost-effective.

(2) Every public improvement contract for lawn and landscape maintenance shall contain a condition requiring the contractor to compost or mulch yard waste material at an approved site, if feasible and cost-effective.

ORS 279C.515 Conditions concerning payment of claims by public officers, payment to persons furnishing labor or materials and complaints.

(1) Every public improvement contract shall contain a clause or condition that, if the contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished to the contractor or a subcontractor by any person in connection with the public improvement contract as the claim becomes due, the proper officer or officers representing the state or a county, school district, municipality, municipal corporation or subdivision thereof, as the case may be, may pay such claim to the person furnishing the labor or services and charge the amount of the payment against funds due or to become due the contractor by reason of the contract.

(2) Every public improvement contract shall contain a clause or condition that, if the contractor or a first-tier subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the public improvement contract within 30 days after receipt of payment from the contracting agency or a contractor, the contractor or first-tier subcontractor shall owe the person the amount due plus interest charges commencing at the end of the 10-day period that payment is due under ORS 279C.580 (4) and ending upon final payment, unless payment is subject to a good faith dispute as defined in ORS 279C.580. The rate of interest charged to the contractor or first-tier subcontractor on the amount due shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is 30 days after the date when payment was received from the contracting agency or from the contractor, but the rate of interest may not exceed 30 percent. The amount of interest may not be waived.

(3) Every public improvement contract and every contract related to the public improvement contract shall contain a clause or condition that, if the contractor or a subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the public improvement contract, the person may file a complaint with the Construction Contractors Board, unless payment is subject to a good faith dispute as defined in ORS 279C.580.

(4) The payment of a claim in the manner authorized in this section does not relieve the contractor or the contractor's surety from obligation with respect to any unpaid claims.

ORS 279C.520 Condition concerning hours of labor.

(1) Every public contract subject to this chapter must contain a condition that a person may not be employed for more than 10 hours in any one day, or 40 hours in any one week, except in cases of necessity, emergency or when the public policy absolutely requires it, and in such cases, except in cases of contracts for personal services as defined in ORS 279C.100, the employee shall be paid at least time and a half pay:

(a) (A) For all overtime in excess of eight hours in any one day or 40 hours in any one week when the work week is five consecutive days, Monday through Friday; or

(B) For all overtime in excess of 10 hours in any one day or 40 hours in any one week when the work week is four consecutive days, Monday through Friday; and

(b) For all work performed on Saturday and on any legal holiday specified in ORS 279C.540.

(2) An employer must give notice in writing to employees who work on a public contract, either at the time of hire or before commencement of work on the contract, or by posting a notice in a location frequented by employees, of the number of hours per day and days per week that the employees may be required to work.

(3) In the case of contracts for personal services as defined in ORS 279C.100, the contract shall contain a provision that the employee shall be paid at least time and a half for all overtime worked in excess of 40 hours in any one week, except for individuals under personal services contracts who are excluded under ORS 653.010 to 653.261 or under 29 U.S.C. 201 to 209 from receiving overtime.

(4) In the case of a contract for services at a county fair or for other events authorized by a county fair board, the contract must contain a provision that employees must be paid at least time and a half for work in excess of 10 hours in any one day or 40 hours in any one week. An employer shall give notice in writing to employees who work on such a contract, either at the time of hire or before commencement of work on the contract, or by posting a notice in a location frequented by employees, of the number of hours per day and days per week that employees may be required to work.

(5) (a) Except as provided in subsection (4) of this section, contracts for services must contain a provision that requires that persons employed under the contracts shall receive at least time and a half pay for work performed on the legal holidays specified in a collective bargaining agreement or in ORS 279C.540 (1)(b)(B) to (G) and for all time worked in excess of 10 hours in any one day or in excess of 40 hours in any one week, whichever is greater.

(b) An employer shall give notice in writing to employees who work on a contract for services, either at the time of hire or before commencement of work on the contract, or by posting a notice in a location frequented by employees, of the number of hours per day and days per week that the employees may be required to work.

ORS 279C.530 Condition concerning payment for medical care and providing workers' compensation.

(1) Every public improvement contract shall contain a condition that the contractor shall promptly, as due, make payment to any person, co-partnership, association or corporation furnishing medical, surgical and hospital care services or other needed care and attention, incident to sickness or injury, to the employees of the contractor, of all sums that the contractor agrees to pay for the services and all moneys and sums that the contractor collected or deducted from the wages of employees under any law, contract or agreement for the purpose of providing or paying for the services.

(2) Every public contract subject to this chapter shall contain a clause or condition that all subject employers working under the contract are either employers that will comply with ORS 656.017 or employers that are exempt under ORS 656.126.

OTHER STATUTORY PROVISIONS**ORS 279A.120 Preference for Oregon goods and services; nonresident bidders.**

(1) As used in this section:

(a) "Nonresident bidder" means a bidder who is not a resident bidder.

(b) "Resident bidder" means a bidder that has paid unemployment taxes or income taxes in this state during the 12 calendar months immediately preceding submission of the bid, has a business address in this state and has stated in the bid whether the bidder is a "resident bidder" under this paragraph.

(3) When a public contract is awarded to a nonresident bidder and the contract price exceeds \$10,000, the bidder shall promptly report to the Department of Revenue on forms to be provided by the department the total contract price, terms of payment, length of contract and such other information as the department may require before the bidder may receive final payment on the public contract. The contracting agency shall satisfy itself that the requirement of this subsection has been complied with before the contracting agency issues a final payment on a public contract.

ORS 279C.570 Prompt payment policy; progress payments; retainage; interest; exception; settlement of compensation disputes.

(1) It is the policy of the State of Oregon that all payments due on a public improvement contract and owed by a contracting agency shall be paid promptly. No contracting agency is exempt from the provisions of this section.

(2) Contracting agencies shall make progress payments on the contract monthly as work progresses on a public improvement contract. Payments shall be based upon estimates of work completed that are approved by the contracting agency. A progress payment is not considered acceptance or approval of any work or waiver of any defects therein. The contracting agency shall pay to the contractor interest on the progress payment, not including retainage, due the contractor. The interest shall commence 30 days after receipt of the invoice from the contractor or 15 days after the payment is approved by the contracting agency, whichever is the earlier date. The rate of interest charged to the contracting agency on the amount due shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date that is 30 days after receipt of the invoice from the contractor or 15 days after the payment is approved by the contracting agency, whichever is the earlier date, but the rate of interest may not exceed 30 percent.

(3) Interest shall be paid automatically when payments become overdue. The contracting agency shall document, calculate and pay any interest due when payment is made on the principal. Interest payments shall accompany payment of net due on public improvement contracts. The contracting agency may not require the contractor to petition, invoice, bill or wait additional days to receive interest due.

(4) When an invoice is filled out incorrectly, when there is any defect or impropriety in any submitted invoice or when there is a good faith dispute, the contracting agency shall so notify the contractor within 15 days stating the reason or reasons the invoice is defective or improper or the reasons for the dispute. A defective or improper invoice, if corrected by the contractor within seven days of being notified by the contracting agency, may not cause a payment to be made later than specified in this section unless interest is also paid.

(5) If requested in writing by a first-tier subcontractor, the contractor, within 10 days after receiving the request, shall send to the first-tier subcontractor a copy of that portion of any invoice, request for payment submitted to the contracting agency or pay document provided by the contracting agency to the contractor specifically related to any labor or materials supplied by the first-tier subcontractor.

(6) Payment of interest may be postponed when payment on the principal is delayed because of disagreement between the contracting agency and the contractor. Whenever a contractor brings formal administrative or judicial action to collect interest due under this section, the prevailing party is entitled to costs and reasonable attorney fees.

(7) A contracting agency may reserve as retainage from any progress payment on a public improvement contract an amount not to exceed five percent of the payment. As work progresses, a contracting agency may reduce the amount of the retainage and the contracting agency may eliminate retainage on any remaining monthly contract payments after 50 percent of the work under the contract is completed if, in the contracting agency's opinion, such work is progressing satisfactorily. Elimination or reduction of retainage shall be allowed only upon written application by the Contractor, and the application shall include written approval of the contractor's surety. However, when the contract work is 97.5 percent completed the contracting agency may, at the contracting agency's discretion and without application by the contractor, reduce the retained amount to 100 percent of the value of the contract work remaining to be done. Upon receipt of a written application by the contractor, the contracting agency shall respond in writing within a reasonable time.

(8) The retainage held by a contracting agency shall be included in and paid to the contractor as part of the final payment of the contract price. The contracting agency shall pay to the contractor interest at the rate of 1.5 percent per month on the final payment due the contractor, interest to commence 30 days after the work under the contract has been completed and accepted and to run until the date when the final payment is

tendered to the contractor. The contractor shall notify the contracting agency in writing when the contractor considers the work complete and the contracting agency shall, within 15 days after receiving the written notice, either accept the work or notify the contractor of work yet to be performed on the contract. If the contracting agency does not, within the time allowed, notify the contractor of work yet to be performed to fulfill contractual obligations, the interest provided by this subsection shall commence to run 30 days after the end of the 15-day period.

(9) (a) The contracting agency shall pay, upon settlement or judgment in favor of the contractor regarding any dispute as to the compensation due a contractor for work performed under the terms of a public improvement contract, the amount due plus interest at the rate of two times the discount rate, but not to exceed 30 percent, on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve district that includes Oregon on the date of the settlement or judgment, and accruing from the later of:

(A) The due date of any progress payment received under the contract for the period in which such work was performed; or

(B) Thirty-days after the date on which the claim for the payment under dispute was presented to the contracting agency by the contractor in writing or in accordance with applicable provisions of the contract.

(b) Interest shall be added to and not made a part of the settlement or judgment.

ORS 279C.580 Contractor's relations with subcontractors.

(1) A contractor may not request payment from the contracting agency of any amount withheld or retained in accordance with subsection (5) of this section until such time as the contractor has determined and certified to the contracting agency that the subcontractor has determined and certified to the contracting agency that the subcontractor is entitled to the payment of such amount.

(2) A dispute between a contractor and first-tier subcontractor relating to the amount or entitlement of a first-tier subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract under subsection (3) or (4) of this section does not constitute a dispute to which the contracting agency is a party. The contracting agency may not be included as a party in any administrative or judicial proceeding involving such a dispute.

(3) Each public improvement contract awarded by a contracting agency shall include a clause that requires the contractor to include in each subcontract for property or services entered into by the contractor and a first-tier subcontractor, including a material supplier, for the purpose of performing a construction contract:

(a) A payment clause that obligates the contractor to pay the first-tier subcontractor for satisfactory performance under its subcontract within 10 days out of such amounts as are paid to the contractor by the contracting agency under the contract; and

(b) An interest penalty clause that obligates the contractor, if payment is not made within 30 days after receipt of payment from the contracting agency, to pay to the first-tier subcontractor an interest penalty on amounts due in the case of each payment not made in accordance with the payment clause included in the subcontract under paragraph (a) of this subsection. A contractor or first-tier subcontractor may not be obligated to pay an interest penalty if the only reason that the contractor or first-tier subcontractor did not make payment when payment was due is that the contractor or first-tier subcontractor did not receive payment from the contracting agency or contractor when payment was due. The interest penalty shall be:

(A) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(B) Computed at the rate specified in ORS 279C.515 (2).

(4) The contract awarded by the contracting agency shall require the contractor to include in each of the contractor's subcontracts, for the purpose of performance of such contract condition, a provision requiring the first-tier subcontractor to include a payment clause and an interest penalty clause conforming to the standards of subsection (3) of this section in each of the first-tier subcontractor's subcontracts and to require each of the first-tier subcontractor's subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(5) (a) The clauses required by subsections (3) and (4) of this section are not intended to impair the right of a contractor or a subcontractor at any tier to negotiate, and to include in the subcontract, provisions that:

(A) Permit the contractor or a subcontractor to retain, in the event of a good faith dispute, an amount not to exceed 150 percent of the amount in dispute from the amount due a subcontractor under

the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties consider appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(B) Permit the contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(C) Permit such withholdings without incurring any obligation to pay a late payment interest penalty if:

(i) A notice conforming to the standards of subsection (8) of this section has been previously furnished to the subcontractor; and

(ii) A copy of any notice issued by a contractor under sub-subparagraph (i) of this subparagraph has been furnished to the contracting agency.

(b) As used in this subsection, "good faith dispute" means a documented dispute concerning:

(A) Unsatisfactory job progress.

(B) Defective work not remedied.

(C) Third-party claims filed or reasonable evidence that claims will be filed.

(D) Failure to make timely payments for labor, equipment and materials.

(E) Damage to the prime contractor or subcontractor.

(F) Reasonable evidence that the subcontract cannot be completed for the unpaid balance of the subcontract sum.

(6) If, after making application to a contracting agency for payment under a contract but before making a payment to a subcontractor for the subcontractor's performance covered by such application, a contractor discovers that all or a portion of the payment otherwise due the subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, the contractor shall:

(a) Furnish to the subcontractor a notice conforming to the standards of subsection (8) of this section as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(b) Furnish to the contracting agency, as soon as practicable, a copy of the notice furnished to the subcontractor under paragraph (a) of this subsection;

(c) Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (a) of this subsection;

(d) Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency;

(e) Make such payment within:

(A) Seven days after correction of the identified subcontract performance deficiency unless the funds therefore must be recovered from the contracting agency because of a reduction under paragraph (f)(A) of this subsection; or

(B) Seven days after the contractor recovers such funds from the contracting agency;

(f) Notify the contracting agency upon:

(A) Reduction of the amount of any subsequent certified application for payment; or

(B) Payment to the subcontractor of any withheld amounts of a progress payment, specifying:

(i) The amounts of the progress payments withheld under paragraph (a) of this subsection;

and

(ii) The dates that such withholding began and ended; and

(g) Be obligated to pay to the contracting agency an amount equal to interest on the withheld payments computed in the manner provided in ORS 279C.570 from the 11th day after receipt of the withheld amounts from the contracting agency until:

(A) The day the identified subcontractor performance deficiency is corrected; or

(B) The date that any subsequent payment is reduced under paragraph (f)(A) of this subsection.

(7) (a) If a contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor a written notice asserting a deficiency in such first-tier subcontractor's performance under the contract for which the contractor may be ultimately liable and the contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the contractor may, without incurring an obligation to pay a late payment interest penalty under subsection (6)(e) of this section:

(A) Furnish to the first-tier subcontractor a notice conforming to the standards of subsection (8) of this section as soon as practicable upon making such determination; and

(B) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under subparagraph (A) of this paragraph.

(b) As soon as practicable, but not later than 10 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the contractor shall pay the amount withheld under paragraph (a)(B) of this subsection to such first-tier subcontractor, or shall incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate specified in ORS 279C.570.

(8) A written notice of any withholding shall be issued to a subcontractor, with a copy to the contracting agency of any such notice issued by a contractor, specifying:

(a) The amount to be withheld;

(b) The specified causes for the withholding under the terms of the subcontract; and

(c) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(9) Except as provided in subsection (2) of this section, this section does not limit or impair any contractual, administrative or judicial remedies otherwise available to a contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by a contractor or deficient performance or nonperformance by a subcontractor.

(10) A contractor's obligation to pay a late payment interest penalty to a subcontractor under the clause included in a subcontract under subsection (3) or (4) of this section is not intended to be an obligation of the contracting agency. A contract modification may not be made for the purpose of providing reimbursement of such late payment interest penalty. A cost reimbursement claim may not include any amount for reimbursement of such late payment interest penalty.

ORS 279C.830 Contractual provisions regarding prevailing rates of wage and fee for administration of law. (1) The specifications for every contract for public works shall contain a provision stating the existing prevailing rate of wage that may be paid to workers in each trade or occupation required for the public works employed in the performance of the contract either by the contractor or subcontractor or other person doing or contracting to do the whole or any part of the work contemplated by the contract. The contract shall contain a provision that the workers shall be paid not less than the specified minimum hourly rate of wage.

(2) The specifications for every contract for public works shall contain a provision stating that a fee is required to be paid to the Commissioner of the Bureau of Labor and Industries as provided in ORS 279C.825 (1). The contract shall contain a provision that the fee shall be paid to the commissioner under the administrative rule of the commissioner

ORS 279C.840 Payment of prevailing rate of wage; posting of rates and fringe benefit plan provisions. (1) The hourly rate of wage to be paid by any contractor or subcontractor to workers upon all public works shall be not less than the prevailing rate of wage for an hour's work in the same trade or occupation in the locality where the labor is performed. The obligation of a contractor or subcontractor to pay the prevailing rate of wage may be discharged by making the payments in cash, by the making of contributions of a type referred to in ORS 279C.800 (1)(a), or by the assumption of an enforceable commitment to bear the costs of a plan or program of a type referred to in ORS 279C.800 (1)(b), or any combination thereof, where the aggregate of any such payments, contributions and costs is not less than the prevailing rate of wage.

STATUTORY REFERENCES OF INTEREST

ORS 279C.525	Provisions concerning environmental and natural resources laws; remedies
ORS 279C.540	Maximum hours of labor on public contracts; holidays; exceptions; liability to workers; rules
ORS 279C.545	Claims for overtime
ORS 279C.550 to ORS 279C.565	Retainage

STATUTORY REFERENCES OF INTEREST *(Continued)*

ORS 279C.585	Authority to substitute undisclosed first-tier subcontractor; circumstances; rules
ORS 279C.590	Complaint process for substitutions of subcontractors; civil penalties
ORS 279C.600 to ORS 279C.625	Bonds
ORS 279C.650 to ORS 279C.670	Termination for Public Interest
ORS 279C.800 to ORS 279C.870	Prevailing Wages

103.13 LABOR

A. Contractor must comply with the City of Gresham's Equal Opportunity Policy for Contractors. The Contractor shall not discriminate against minorities, women, or emerging small business enterprises in the awarding of subcontracts.

B. Upon notification in writing from the Manager, remove immediately from the job for its duration any laborer, workman, mechanic, foreman, superintendent, or other person employed who is found to be incompetent, intemperate, troublesome, disorderly or otherwise objectionable, or who fails or refuses to perform their work properly or acceptably.

C. Comply with ORS Chapter 659 relating to unlawful employment practices and discrimination by employers against any employee or applicant for employment because of race, religion, color, sex, or national origin. Particular reference is made to ORS 659.030, which states that it is unlawful employment practice for any employer, because of the race, religion, color, sex, or national origin of any individual, to refuse to hire or employ or to bar or discharge from employment such individual or to discriminate against such individual in compensation or in terms, conditions or privileges of employment.

103.14 PREVAILING WAGES *(Not applicable to privately financed public improvements)*

The Contractor shall comply with ORS 279C.800 to 279C.870, Oregon's Prevailing Wage Law. For public works for which the Contract Price is \$25,000 or more, all workers shall be paid not less than such specified minimum hourly rate of wage. The Contractor shall pay a fee to the Commissioner of the Bureau of Labor and Industries as required by ORS 279C.825(1) and pursuant to the administrative rule of the commissioner.

103.15 OVERTIME FOR CITY PERSONNEL

A. The Contractor shall notify the Project Manager of any overtime operations as soon as possible but no less than 48-hours before the work is to occur. The Contractor must provide documentation to the Project Manager's satisfaction detailing when and for how long the overtime work will occur.

B. For publicly financed public improvement projects, in the event that the Contractor wishes to proceed with an overtime operation, the Contractor must first notify and obtain approval from the Project Manager to do so, prior to commencing such work.

C. For overtime work the Contractor shall pay the applicable wage rate, including fringe benefits, for the City's personnel, and other staff required at the project during the overtime hours at 1.5 times the regular rate of pay for all overtime worked, except for holidays where the rate will be 2.5 times the regular rate of pay.

D. This subsection does not apply to labor performed in the manufacture or fabrication of any material ordered by the Contractor or manufactured or fabricated in any plant or place other than the place where the main work is to be performed.

E. Overtime is defined as hours outside of the hours of an employee's regularly scheduled 40-hour workweek. Work performed on City-recognized holidays would also constitute overtime.

103.16 SAFETY

A. Employee Safety:

The Contractor shall at all times be responsible for the safety of their employees and their subcontractor's employees. The Contractor shall maintain the job site and perform the work in a manner which meets the Contractor's (and the City's, if any) responsibility under statutory and common law for the provision of a safe place to work and which complies with safety regulations. Conduct the project with proper regard for the safety and convenience of the public. When the project involves use of public ways, provide necessary flag persons and install and maintain means of reasonable access to all fire hydrants, service stations, warehouses, stores, houses, garages, and other property. Private residential driveways shall be closed only with approval of the Engineer or specific permission of the property owner. Do not interfere with normal operation of public transit vehicles unless otherwise authorized. Do not obstruct or interfere with travel over any public street or sidewalk without approval. At all times provide open trenches and excavations with secured and adequate barricades or fences of a type approved by the City that can be seen from a reasonable distance. Close up or plate all open excavations at the end of each working day in all street areas unless approved otherwise by the Manager and in all other areas when it is reasonably required for public safety or as directed by the Manager. At night, mark all open work and obstructions by lights. Install and maintain all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities. Observe all safety instructions received from the Manager or governmental authorities, but following of such instructions shall not relieve the Contractor from its responsibility or liability for accidents to workers or damage or injury to person or property. The City, the Project Manager, the Engineer, and the Inspector shall have no obligation or duty to monitor or enforce the Contractor's safety responsibility.

B. Public Safety and Convenience:

The Contractor shall at all times conduct their work so as to ensure the least possible obstruction to traffic and convenience to the general public and residents in the vicinity of the work and to ensure the protection of persons and property. No road or street shall be closed to the public except with the permission of the Transportation Engineer and proper governmental authority. Fire hydrants on or adjacent to the work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the use and proper functioning of sidewalks, private and public driveways, all gutters, sewer inlets, drainage ditches and culverts, irrigation ditches, and natural watercourses. The Contractor will minimize inconvenience to others due to mud and dust.

C. Safety Program:

The Contractor shall adopt a written safety program complying with the requirements of employee and public safety set forth hereinabove and any applicable Special Provisions. The safety program shall also comply with OAR Chapter 437, Division 3 and 29 CFR Part 1926 regarding general safety and health provisions.

103.17 TWO (2) YEAR WARRANTY

A. In addition to and not in lieu of any other warranties required under the Contract Documents, make all necessary repairs and replacements to remedy, in a manner satisfactory to the Project Manager and at no cost to the City, the failure to conform with Contract Documents including installation of any sidewalk conditioned to the development that is not constructed, and any and all defects, breaks, or failures of the work due to faulty or inadequate materials or workmanship occurring within two (2) years following the date of signature by the Contractor of the Certificate of Final Completion (on publicly financed public improvement projects) or following the date of acceptance of the public facilities for ownership and operation (for privately financed public improvement projects). Additionally, on privately financed public improvement projects, the warranty shall cover failures of the design by the Engineer of Record that are discovered during the same warranty period.

B. In addition to and not in lieu of any other warranty required under the Contract Documents, furnish any and all manufacturer's and installer's standard warranty forms setting forth terms, conditions, and limitations. Contractor shall enforce such warranties during the two-year warranty period described in **Subsection 103.17(A)**. Contractor hereby assigns such warranties to the City.

C. Repair damage or disturbances to other improvements under, within, or adjacent to the work, whether or not caused by settling, washing, or slipping, when such damage or disturbance is caused, in whole or in part, from

activities of the Contractor in performing their duties and obligations under the Contract Documents when such defects or damage occur within the warranty period.

D. If performance of warranty work results in a street being cut or dug up, the Contractor shall comply with **Subsection 103.18** at no expense to the City.

E. The two-year warranty period and warranty guarantee shall, with relation to any required repair, be extended two years from the date of completion of such repair.

F. If the Contractor, after written notice, fails within 2 months to complete the necessary warranty work in compliance with the terms of this subsection, the City may have the defects corrected, and the Contractor and the surety shall be liable for all expenses incurred. In case of an emergency where, in the opinion of the Manager, delay would cause serious loss or damage, repairs may be made without notice being given to the Contractor, and the Contractor or the surety shall pay the cost of repairs. Failure of the Manager to act in case of an emergency shall not relieve the Contractor or the surety from liability and payment of all such costs.

G. City of Gresham waterline facilities that require repair or replacement during the two-year warranty period shall be repaired by the City or under the direction of the City and the Contractor and the surety shall be liable for all expenses incurred.

103.18 STREET CUT/DIG MORATORIUM AFTER MAJOR STREET WORK

Moratorium After Major Street Work:

(a) The surface of any street shall not be cut or dug up for a period of three years after acceptance by the City of a street improvement, capital improvement, or major maintenance work.

(b) If such delay would cause undue hardship for the applicant, property owner, or other person, the Manager may grant an exception. Such an exception shall be subject to any of the following conditions:

- 1) That the applicant pays the estimated cost of a 1½" full width overlay or grind and inlay of the entire street or construct such overlay or grind and inlay.
- 2) That the applicant pay a portion of the cost of a 1½" overlay or grind and inlay in addition to making repairs as directed by the City.
- 3) That the applicant pay its fair share of the cost of street repair equal to the Manager's estimate of the cost of reduced street life and future repairs in addition to making the repair as directed by the City.
- 4) That the applicant restores the street to the condition that existed prior to construction and warrants such repairs for the estimated life of the street.

103.19 OWNERSHIP OF WORK *(Not applicable to privately financed public improvements)*

All work products of the Contractor that result from the Contract, including but not limited to background data, documentation, and staff work that is preliminary to final reports, are the property of the City. Draft documents and preliminary work submitted to the City for review and comment shall not be considered as owned, used, or retained by the City until the final document is submitted.

The City shall own all proprietary rights, including but not limited to copyrights, trade secrets, patents, and all other intellectual or other property rights in and to such work products. Preexisting trade secrets of the Contractor shall be noted as such and shall not be considered as a work product of the Contract. All such work products shall be considered "works made for hire" under the provisions of the United States Copyright Act and all other equivalent laws.

Any materials designated as "confidential" that may be provided to the Contractor by the City at any time relating to the Contract Documents shall be treated confidentially by the Contractor, and shall not be disclosed to any other person by the Contractor without the advance written permission of the Project Manager. The Contractor shall return all confidential materials upon request.

Use of any work product of the Contractor by the City for any purpose other than the use intended by the Contract Documents is at the risk of the City. Use of any work product by the Contractor is prohibited without the written consent of the City.

103.20 CONTRACTOR IS INDEPENDENT CONTRACTOR *(Not applicable to privately financed public improvements)*

A. The Contractor shall perform the work required by the Contract as an independent contractor. Although the City reserves the right (i) to specify the desired results; (ii) to determine (and modify) the delivery schedule for the work to be performed; and (iii) to evaluate the quality of the completed performance, the City cannot and will not control the means or manner of the Contractor's performance. The Contractor is responsible for determining the appropriate means and manner of performing the work.

B. The Contractor represents and warrants that Contractor (i) is not currently an employee of the Federal Government or the State of Oregon, and (ii) meets the specific independent contractor standards of ORS 670.600. The Contractor represents and warrants that all subcontractors shall also meet such independent contractor standards.

C. The Contractor will be responsible for any federal or state taxes applicable to any compensation or payment paid to the Contractor under the Contract.

D. The Contractor is not eligible for any federal Social Security, unemployment insurance, state Public Employees' Retirement System, or workers' compensation benefits from compensation or payments to the Contractor under the Contract.

103.21 SUCCESSORS IN INTEREST *(Not applicable to privately financed public improvements)*

The provisions of the Contract shall be binding upon and shall inure to the benefit of the parties hereto, and their respective successors and approved assigns, if any.

103.22 REGISTRATION WITH CONSTRUCTION CONTRACTOR'S BOARD

The Contractor shall be licensed with the Construction Contractors Board in accordance with ORS 701.035 to 701.055. All subcontractors performing work as described in ORS 701.005(2) (i.e., construction work) shall be licensed with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 before the subcontractors commence work.

103.23 SEVERABILITY

If any term or provision of the Contract Documents are declared by a court of competent jurisdiction to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Contract Documents did not contain the particular term or provision held invalid.

103.24 MERGER CLAUSE *(Not applicable to privately financed public improvements)*

The Contract constitutes the entire agreement between the parties. No waiver, consent, modification, or change of terms of the Contract shall bind either party unless in writing and signed by both parties. Such waiver, consent, modification, or change, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein regarding the Contract. By its signature, the Contractor acknowledges it has read and understands the Contract, and agrees to be bound by its terms and conditions.

103.25 NO THIRD-PARTY BENEFICIARIES *(Not applicable to privately financed public improvements)*

The City and the Contractor are the only parties to the Contract and are the only parties entitled to enforce its terms. Nothing in the Contract gives or provides any benefit or right, whether directly, indirectly, or otherwise, to

third persons unless such third persons are individually identified by name and expressly described as intended beneficiaries of the terms of the Contract.

103.26 EXAMINATION OF THE CONTRACT DOCUMENTS, SITE OF WORK, AND SUBSURFACE DATA

A. The submission of an offer shall be conclusive evidence that the Bidder has investigated and is satisfied as to the site subsurface conditions to be encountered, as to the character, quality, and quantities of work to be performed and materials to be furnished, and as to the requirements of the Contract Documents.

B. The City will not pay any costs incurred by any Bidder in the submission of an offer or in making necessary studies, subsurface investigations, or designs for the preparation of an offer.

103.27 FAMILIARITY WITH LAWS AND ORDINANCES

A. The Bidder shall be familiar with all federal, state, and local laws, ordinances, and regulations that in any manner affect those engaged or employed in the work or the materials or equipment used in the proposed construction, or which in any way affect the conduct of the work. If the Bidder or the Contractor discovers any provision in the Contract Documents that is contrary to or inconsistent with any law, ordinance, or regulation, it shall immediately be reported to the Project Manager in writing.

B. Pursuant to ORS 279C.525, the following is a list of federal, state and local agencies that have enacted ordinances or regulations dealing with the prevention of environmental pollution and the preservation of natural resources that may affect the performance of the Contract.

Federal Agencies:

Agriculture, Department of
Army Corps of Engineers
Coast Guard
Defense, Department of
Energy, Department of
Environmental Protection Agency
Federal Energy Regulatory Commission
Federal Highway Administration
Forest Service
Health and Human Services, Department of
Housing and Urban Development, Department of
Indian Affairs, Bureau of
Interior, Department of
Labor, Department of
Land Management, Bureau of
Mine Safety and Health Administration
Mines, Bureau of: Geological Survey
Minerals Management Service
Reclamation, Bureau of
Natural Resources Conservation Service
Occupational Safety and Health Administration
Solar Energy and Energy Conservation Bank
Transportation, Department of
U.S. Fish and Wildlife Service
Water Resources Council

State Agencies:

Administrative Services, Department of
Agriculture, Department of
Columbia River Gorge Commission
Consumer and Business Services, Department of

State Agencies: *(Continued)*

Energy, Department of
Environmental Quality, Department of
Fish and Wildlife, Department of
Forestry, Department of
Geology and Mineral Industries, Department of
Human Resources, Department of
Land Conservation and Development Commission
Oregon Occupational Safety and Health Division
Parks and Recreation, Department of
Soil and Water Conservation Commission
State Engineer
State Land Board (Division of State Lands)
Water Resources Department

Local Agencies:

City Councils
County Commissioners, Board of
County Courts
County Service Districts
Fire Protection Districts
Historical Preservation Commissions
Metropolitan Service Districts
Planning Commissions
Port Districts
Sanitary Districts
Water Districts

C. The Contractor and their subcontractors shall obtain a City of Gresham business license prior to beginning any work within the City of Gresham.

104 AWARD AND EXECUTION OF THE CONTRACT

104.01 AWARD OF THE CONTRACT *(Not applicable to privately financed public improvements)*

A. The City will award the Contract to the responsible Bidder with the lowest responsive offer.

B. While price extensions are required as a matter of convenience, in the event of error in extensions, the unit prices shall govern. In the event of discrepancy between the written and numerical amounts, the written prices will govern.

C. Award and issuance of the Contract for signing shall be made within forty-five (45) calendar days, unless otherwise specified, after the date of opening of offers.

D. If all responsive offers from responsible Bidders exceed the City's cost estimate, the City may elect to negotiate with the lowest responsive, responsible Bidder prior to awarding the Contract, in order to solicit value engineering and other options to attempt to bring the project within the City's cost estimate. Negotiation will not result in significant changes from the scope of the project in the Contract Documents.

E. Preference may be given to services, articles, or materials produced or manufactured in Oregon if price, fitness, availability, and quality are otherwise equal.

104.02 SELECTION PROTEST *(Not applicable to privately financed public improvements)*

Upon selection of the Contractor, the Project Manager shall issue a Notice of Intent to Award. A Bidder adversely affected or aggrieved may protest the Notice of Intent to Award. No protest because of a solicitation provision, evaluation criteria, plan, specification or contract term that could have been raised as a Solicitation Protest will be considered. The selection protest must be submitted in writing within seven calendar days of the date of the Notice of Intent to Award. The protest shall be submitted to the Project Manager.

The selection protest must state all the relevant facts that establish that all lower bidders were ineligible for selection because their offers were non-responsive or the City committed a substantial violation such that the protester would have, but for the substantial violation, been the lowest responsible bidder. A written decision will be sent to the protester.

104.03 EXECUTION OF THE CONTRACT *(Not applicable to privately financed public improvements)*

A. The Bidder to whom award is made shall execute and return the Contract in the required number of copies, and shall furnish separate performance bond and payment bonds and certificates of insurance satisfactory to the Manager and Attorney within fifteen (15) days after issuance of the Contract. The date of the Contract will be the date the Manager or designee executes the Contract.

B. Drug Testing

1. The Contractor awarded the Contract shall certify to the City that it has a drug-testing program in place for its employees that includes, at a minimum, the following:

(a) A written employee drug-testing policy,

(b) Required drug testing for all new Subject Employees or alternatively, required testing of all Subject Employees every 12 months on a random selection basis, and

(c) Required testing of a Subject Employee when the Contractor has reasonable cause to believe the Subject Employee is under the influence of drugs.

2. A drug-testing program that meets the above requirements will be deemed a "Qualifying Employee Drug-testing Program." An employee is a "Subject Employee" only if that employee will be working on the project job site.

3. By executing and returning the Contract, the Contractor certifies, represents, and warrants to the City that a Qualifying Employee Drug-testing Program is in place at the time of execution, will continue in full force and effect for the duration of the Contract, and that the Contractor will comply with the provisions of **Subsection 103.03(C)**. Further, the City's performance obligation (which includes, without limitation, the City's obligation to make payment) is contingent on the Contractor's compliance with this representation and warranty.

104.04 TRANSFER OF THE CONTRACT AND INTERESTS THEREIN *(Not applicable to privately financed public improvements)*

A. Excepting Surety assignment under the performance and payment bonds, the Contract is not assignable to any other party or parties without the prior written consent of the Manager. In case of such attempted transfer without permission, the Manager may refuse to carry out the Contract either with the Contractor or the transferee, but all rights of action for any breach of the Contract by said Contractor are reserved to the City. No officer of the City, or any person employed in its service, is or shall be permitted any share or part of the Contract or is or shall be entitled to any benefit which may arise from the Contract.

B. Any assignment of money shall be subject to all proper setoffs and withholdings in favor of the City and to all deductions provided for in the Contract and particularly all money withheld, whether assigned or not, shall be subject to being used by the City for completion of the work in the event the Contractor should be in default therein.

104.05 PERFORMANCE AND PAYMENT BONDS; WARRANTY GUARANTEE

Guarantee of performance and warranty guarantee requirements for privately financed public improvements can be found in **Subsection 101.06**.

At the time of execution of the Contract, the Contractor shall furnish separate Performance and Payment Bonds written by a corporate surety, or other financial assurance approved by the Manager and Attorney, each in an amount equal to the contract price based upon the estimate of quantities and unit prices or lump sum as set forth in the Contract. The bonds shall be continuous in effect and shall remain in full force and effect until compliance with and fulfillment of all terms and provisions of the Contract, including the warranty obligation of **Subsection 103.17**, all applicable laws, and the prompt payment of all persons supplying labor and/or material for prosecution of the work. The bonds or other financial assurance is subject to approval by the Manager and Attorney.

In lieu of the performance and payment bonds, including the warranty obligation, the Contractor may request to furnish a separate warranty bond written by a corporate surety or other financial assurance, in an amount equal to 10% of the final Contract Price. The warranty bond or other financial assurance shall be in effect for a period of two years from the date of Final Completion. The Project Manager may require a separate warranty bond or financial assurance for any repairs done pursuant to the warranty obligation. Such separate warranty bond or financial assurance shall be for a period of two years from the date of completion of such repairs.

104.06 CERTIFICATE OF INSURANCE *(Not applicable to privately financed public improvements)*

Work shall not commence until all insurance required by the Contract has been obtained and the Attorney has approved Certificate(s) of Insurance. The Contractor shall maintain insurance throughout the life of the Contract.

104.07 FAILURE TO EXECUTE THE CONTRACT *(Not applicable to privately financed public improvements)*

Failure on the part of the Bidder to whom the Contract is awarded to execute the Contract and to deliver the Contract, the required performance and payment bonds and the certificate of insurance shall be just cause for cancellation of the award, withdrawing of the Contract and forfeiture of the Bid Security to the City. Award may then be made to the next lowest responsible and responsive Bidder, or the work may be re-advertised, or otherwise, as the City may decide.

104.08 RETURN OF BID SECURITY *(Not applicable to privately financed public improvements)*

The bid security of unsuccessful Bidders will be returned after the offers have been opened and the Contract has been awarded. The City reserves the right to retain the bid security of the three (3) lowest Bidders until the Contract has been signed and returned. The bid security of the Contractor shall be returned upon execution of the Contract by the City.

105 SCOPE OF WORK

105.01 PLANS AND SPECIFICATIONS

The Contract Documents will govern the work to be done. Anything mentioned in the specifications and not shown on the plans, or shown on the plans and not mentioned in the specifications, shall be of like effect as though shown or mentioned in both. Specifications and plans referred to in any part of the Contract Documents shall be considered as being included in the document in which such reference is made. When a particular Standard Detail or Standard Specification is referred to, such reference shall be to the Standard Detail or Standard Specification that is in force at the time of the Notice to Contractors. The phrases, "Contractor shall", "Contractor will", etc. may not always be specifically stated in all paragraphs but is considered understood where not specifically stated otherwise.

105.02 PRECEDENCE OF THE CONTRACT DOCUMENTS

In case of conflict, the order of precedence of the following documents in controlling the work shall be:

1. CIP Agreement (for publicly financed public improvements)
2. Offer (for publicly financed public improvements)
3. Permits from outside agencies required by law
4. Special Provisions
5. Project Specific Plans (for publicly financed public improvements)
6. Special Specifications
7. The *Public Work Standards*, including Design Standards, Standard Details Drawings and Construction Standard Specifications
8. Approved Plans (for privately financed public improvements)
9. Standard Specifications for Construction (ODOT/APWA latest revision)

Addenda, change orders, supplemental agreements, and approved revisions to plans and specifications will take precedence over the contract documents listed above.

105.03 SHOP DRAWINGS AND OTHER SUBMITTALS

A. Plans and specifications furnished and included with the Contract Documents indicate the work proposed and the results that are intended to be accomplished.

B. Unless otherwise specified, furnish all layout, detail, shop, and working drawings, product data and samples required by the plans and specifications to be submitted or as requested by the Engineer. Drawings shall be of sufficient size and scale to clearly show details and six (6) copies shall be provided. After review and approval by the Engineer, two copies will be returned to the Contractor.

C. By submitting drawings, product data and samples, the Contractor represents that they have determined and verified all materials, field measurements, and field construction criteria related thereto, and that they have checked and coordinated the information contained within such submittals with the requirements of the work and of the Contract Documents and that they are satisfied they conform to the Contract Documents.

D. All required drawings, product data and samples shall be furnished to the Project Manager for review and any required testing before any of the work or related work is performed, or products or material ordered prior to the Project Manager's review and completion of any testing will be at the Contractor's risk.

E. The Engineer will review all drawings, product data, and samples and conduct such tests as are required by the Contract Documents within a reasonable time but in no event will the Engineer be required to complete such review or conduct such tests in less than fourteen (14) days after submission. The Engineer will return marked-up submittal copies indicating one of the following actions:

1. If review and checking indicate no exceptions, copies will be returned marked "NO EXCEPTIONS TAKEN" and work may begin immediately on incorporating the material or equipment covered by the submittal into the work.

2. If review and checking indicate limited corrections are required, copies will be returned marked, "MAKE CORRECTIONS NOTED", and upon making the corrections noted, work may begin immediately to incorporate the material or equipment covered by the submittal into the work.

3. If review and checking indicate insufficient or incorrect data have been submitted, copies will be returned marked "REVISE AND RESUBMIT." No work may begin on incorporating the material or equipment covered by the submittal into the work until the submittal is revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" OR "MAKE CORRECTIONS NOTED."

4. If review and checking indicate the material or equipment submittal is unacceptable, copies will be returned marked "REJECTED." No work may begin on incorporating the material or equipment covered by the

submittal into the work until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" OR "MAKE CORRECTIONS NOTED."

5. If review and checking indicate additional information is required, copies will be returned marked "SUBMIT SPECIFIED ITEM." Work may begin immediately on incorporating the material or equipment covered by the submittal into the work, only if it is not affected by the item to be submitted. If any material or equipment is affected, no work may begin on incorporating that material or equipment into the work until it and the submittal are submitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

F. The review by the Engineer of any shop drawings, product data, samples, construction methods and equipment or other submittals is only for conformance with the general design concept of the project and does not extend to consideration of structural integrity, safety, detailed compliance with Contract Documents, or any other obligation of the Contractor. Any work shown is subject to the requirements of the plans and specifications. The Contractor is responsible for confirming and correlating all dimensions; fabricating, and construction techniques; coordinating their entire work in strict accordance with the Contract Documents. The review does not relieve the Contractor from their obligation fully to perform all requirements of the Contract Documents, nor shall such review give rise to any right of action or suit in favor of the Contractor or third persons against the Engineer or the City.

105.04 CHANGES IN THE WORK

A. Without notice to a surety, the City may, at any time, order additions, deletions or revisions in the Work. A written amendment, a change order, or a work directive will authorize these additions, deletions or revisions.

B. Upon receipt of any such document, the Contractor shall promptly proceed with the work under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

105.05 FORCE ACCOUNT WORK *(Not applicable to privately financed public improvements)*

The Contractor shall perform work on a force account basis upon written notice by the Project Manager. If the Project Manager determines the work increases the amount due under the Contract, payment will be made pursuant to **Subsection 109.04(A)(3)**, Method 3 – FORCE ACCOUNT WORK.

105.06 SALVAGE

When shown or specified, carefully salvage and stockpile within the construction area all castings, pipe, and any discarded facilities, to be disposed of by the City. If directed by the Project Manager, the Contractor shall deliver any discarded facilities to a location designated by the Project Manager.

106 PROSECUTION AND PROGRESS OF WORK

106.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. One (1) week in advance of starting work, submit for written approval a proposed construction schedule to the Project Manager. The Contractor shall not commence work until the construction schedule is approved by the Project Manager.

B. If it is desirable to carry on operations in more than one location simultaneously, submit a schedule that addresses all locations at least one (1) week in advance of beginning such operations.

C. If the Contractor's proposed construction schedule does not meet the necessary construction program schedule as determined by the Project Manager, immediately submit a revised construction schedule for approval. The Contractor shall not commence work until the revised construction schedule is approved by the Project Manager.

D. The schedule shall show the proposed order of work and indicate the time required for completion of the major items of work. This working schedule shall take into account the passage and handling of traffic with the least practicable interference therewith and the orderly, timely, and efficient prosecution of work. It will also be used as an indication of the sequence of the major construction operations and as a check on the progress of work.

E. At any time the Project Manager considers that the work, or any portion of the work, is more than 10% behind the approved schedule, or whenever the Project Manager reasonably requests, the Contractor shall submit an updated schedule to the Project Manager for review and approval.

106.02 PRECONSTRUCTION CONFERENCE

Attend a preconstruction conference, if requested, at a time prior to start of work designated by the Project Manager. Comply with information and instructions provided at the preconstruction conference as recorded in the minutes of the meeting. Representative(s) of the Contractor expected to be directly involved with the project shall be in attendance.

106.03 CONTRACTOR'S REPRESENTATIVE

Designate in writing before starting work an authorized representative who shall have complete authority to represent and to act for the Contractor. The Contractor or its authorized representative shall supervise the work, and shall be present onsite continually during its progress. If the Contractor or its authorized representative is not present, the Engineer may give directions to the apparent person in charge at the site and such directions shall be received and followed. Any direction will be confirmed in writing upon request from the Contractor.

106.04 NOTICE TO PROCEED

Notice to Proceed requirements for privately financed public improvements can be found in **Subsection 101.05**.

A. Unless stated otherwise in the Special Provisions, written Notice to Proceed will be given by the Project Manager within 30-days of the date of the Contract. Do not commence work under the Contract until such written notice has been given. Notify the Project Manager forty-eight (48) hours in advance of the time and place work will be started.

B. Notice to Proceed may be delayed by the Project Manager up to an additional thirty (30) days (for a total of sixty (60) days) from date of the Contract if, in the Project Manager's opinion, necessary easements or permits have not been obtained, or required utility relocation, construction, or reconstruction has not been completed or has not progressed to a degree that will allow work to commence.

C. Commence work within 10 working days after the date of the Notice to Proceed, or such other date as may be fixed by the Notice to Proceed. The date work is required to begin establishes the commencement date of the Contract time.

106.05 CONTRACT TIME

Time requirements for the completion of privately financed public improvements can be found in **Subsection 101.07**.

A. Time shall be considered of the essence of the Contract.

B. Upon commencement of work, the Contractor shall provide adequate labor, materials, and equipment, and work shall be performed vigorously and continuously in accordance with a schedule that will ensure completion within the specified time limit. Failure to diligently pursue the work may jeopardize additional contract time.

C. Work shall be completed within the specified contract time.

106.06 SUSPENSION OF WORK

A. If the work is suspended for public interest: Temporarily suspend work on the project wholly or in part for public interest as directed by the Manager. In the event of such suspension, the Manager shall, except in emergency and except as hereinafter provided, give the Contractor three (3) days notice. For publicly financed public improvements, work shall be resumed within five (5) days after notice has been given by the Manager to the Contractor to do so. The Manager shall allow the Contractor an extension of time for completion corresponding to the total period of temporary suspension. The Contractor will be entitled to recover damages limited to reimbursement for necessary rental of unused equipment, services of watch persons, documented direct overhead costs, documented direct unavoidable expenses accruing by reason of the suspension, plus fifteen percent (15%) of the foregoing to cover Contractor's profit. The Contractor shall not be entitled to indirect costs or any other damages arising out of the delay, including but not limited to interruption of schedules, or any other impact claim or ripple effect.

B. If work is suspended by the Manager: Immediately suspend work on the project, wholly or in part, as directed by the Manager, for reasonable periods of time as the Manager may deem necessary, when conditions are unsuitable for satisfactory performance of the work. For publicly financed public improvement projects the City shall allow the Contractor an extension of time for completion corresponding to the total period of suspension, but the Contractor shall not be entitled to reimbursement for any costs or damages arising under this clause.

C. If work is suspended for cause: The Contractor agrees to immediately suspend work on the project as directed by the Manager if the Manager determines any of the following conditions exist: (1) failure to correct unsafe conditions for working personnel, the general public, or the City's employees, (2) failure to immediately correct defective and unacceptable work in accordance with **Subsection 107.16**, (3) failure to carry out provisions of the Contract Documents, and (4) failure to carry out orders or directives. The Manager may direct all or a portion of the work be suspended and the conditions under which work may commence.

D. Voluntary suspension by the Contractor: Such suspension shall not relieve the Contractor from the responsibility to complete the work within the prescribed time specified in the Contract Documents. Should operations be discontinued, the Contractor shall notify, in writing, the Project Manager at least twenty-four (24) hours in advance of resuming operations. For publicly financed public improvement projects, there shall be no voluntary suspension or slowing of operations without the prior written approval of the Project Manager and such approval shall not relieve the Contractor from the responsibility to complete the work within the prescribed time in the Contract Documents.

E. Responsibilities of the Contractor:

1. At the commencement of and during any suspension of work, protect all work performed to prevent any damage or deterioration of the work. Provide temporary protection devices to warn, safeguard, protect, guide, and inform traffic during suspension, the same as though the work had been continuous and without interferences.

2. Bear all costs for providing suitable provisions for traffic control and for maintenance and protection of the work during suspension unless the suspension was for convenience.

F. In all cases of suspension, except voluntary suspension by the Contractor, work will be resumed only upon written order of the Project Manager.

106.07 DELAYS AND EXTENSIONS OF TIME *(Not applicable to privately financed public improvements)*

A. If the Contractor is significantly delayed due to court orders enjoining the prosecution of the project, unavoidable strikes, earthquake, flood, cloudburst, tornado, hurricane, or other phenomenon of nature of catastrophic proportions or intensity, unusual and extraordinary action of the elements that are of such severity to stop all progress of the work, or act or neglect of the City not authorized by the Contract, the Contractor shall, within forty-eight (48) hours of the start of the occurrence, give notice to the Project Manager of the cause of the potential delay and estimate the possible time extension involved. Within ten (10) days after the cause of the delay has been remedied the Contractor shall give notice to the Project Manager of any actual time extension requested as a result of the aforementioned occurrence in accordance with **Subsection 109.05**, Claims and Notice.

B. No extension of time will be considered for weather conditions normal to the area and time of year in which the work is being performed. Delays in delivery of equipment or material purchased by the Contractor or subcontractors (including the City-selected equipment) shall not be considered as a just cause for delay, when timely ordering would have made the equipment available. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials. Extensions of time will be considered for delayed delivery of the City-specified equipment "without equal."

C. Within a reasonable period after the Contractor submits to the Project Manager a written request for an extension of time, the Project Manager will make the decision on each request. All extensions of time shall be approved by the Manager.

D. An adjustment of Contract time as herein provided shall be the Contractor's sole remedy for any delay in completion of the project arising from causes beyond the control of the Contractor, except for unreasonable delay caused by acts or omissions of the City or persons acting therefore. In no event shall the Contractor be entitled to collect or recover any damages, loss or expense incurred by reason of such delay, except for an unreasonable delay caused by acts or omissions of the City or persons acting therefore.

E. If the Contractor is delayed due solely to a breach by the City, the Contractor will be entitled to recover damages limited to reimbursement for necessary rental of unused equipment, services of watch persons, documented direct overhead costs, documented direct unavoidable expenses accruing by reason of the suspension, plus fifteen percent (15%) of the foregoing to cover Contractor's profit. The Contractor shall not be entitled to indirect costs or any other damages arising out of the delay, including but not limited to, interruption of schedules, or any other impact claim or ripple effect. If a delay is caused by the City and the Contractor (joint delay), the Contractor shall only be entitled to a time extension.

106.08 *CONTRACT INCENTIVE AND LIQUIDATED DAMAGES (Not applicable to privately financed public improvements)*

A. If the Contractor fails to complete the project or to deliver the supplies or perform the services within the time specified in the Contract or any extension thereof by the City, the actual damage to the City for the delay will be substantial but will be difficult or impractical to determine. If the Contractor completes the project before the time specified in the Contract or any extension thereof by the City, the City shall receive a benefit by reason of the early completion.

B. It is therefore agreed that, if a per diem amount for a contract incentive is included in a Special Provision, the City shall pay to the Contractor the per diem amount for each and every calendar day the work is substantially and/or finally complete as specified before the time established in the Special Provision. Notwithstanding whether a contract incentive is provided, the Contractor will pay to the City, not as a penalty but as liquidated damages, the per diem amount for each and every calendar day elapsed in excess of the Contract time or the final adjusted Contract time for final completion applicable to the work required under the Contract.

C. Permitting the Contractor to continue and finish the work or any part thereof after the Contract time or adjusted Contract time, as pertinent, has expired shall in no way operate as a waiver on the part of the City or any of its rights under the Contract.

D. Payment of a contract incentive or liquidated damages shall not release the Contractor from obligations in respect to the fulfillment of the entire Contract, nor shall the payment constitute a waiver of the City's right to collect damages which may be sustained by failure of the Contractor to carry out the terms of the Contract, it being the intent of the parties that the contract incentive or liquidated damages be full and complete payment only related to the timely completion of the work.

106.09 *RECORD DRAWINGS*

The Contractor shall maintain, at the site, one set of clean, readable plans, specifications, full-size drawings, shop drawings, and supplemental drawings that shall be available for inspection by the City. Upon completion of the work, the Contractor's field as-built drawings shall be turned over to the Project Manager prior to

final payment or release of funds by the City. For privately financed public improvements, submission of drawings, conforming to **Subsection 2.06**, is required prior to final acceptance.

106.10 CONFLICTS, ERRORS, OMISSIONS, AND ADDITIONAL DRAWINGS

Check and compare all plans and specifications prior to construction and notify the Engineer of Record and the Project Manager of any discrepancies or omissions in order to permit correction by the Engineer of Record. Coordination of plans and specifications is intended. Furnish labor and materials as required for the work. Should any work or materials be reasonably required or intended for carrying the project to completion that are omitted on the plans and specifications, furnish same as fully as if particularly delineated or described. The intent of the plans and specifications is to show and describe a complete project within the limits stated. Dimensions shown on plans shall be followed, rather than scale measurements. Whenever the plans are not sufficiently detailed or explicit, the Engineer of Record will be required to furnish additional detail drawings or written instructions at the request of the Contractor or the City. The Contractor shall perform the work in accordance with the additional details or instructions.

106.11 THE CITY'S RIGHT TO DO WORK

Failure or refusal to comply with any of the terms or conditions of the Contract Documents will permit the City to supply or correct any deficiency or defect or take other appropriate action without prejudice to any other remedy. Such action by the City shall be taken only after seven (7) days notice by the Manager to the Contractor and their surety, unless in the judgment of the Manager an emergency or danger to the work or to the public exists, in which event action of the City as set forth above may be taken without any notice whatsoever. The cost of such action by the City shall be at the Contractor's expense and shall be billed to the Contractor or deducted from payment owed the Contractor. The Contractor remains fully responsible for all aspects of the Contract Documents, even if this right is exercised. Nothing in this subsection shall be construed to require the City to do any work to cure any deficiency or defect.

106.12 TERMINATION FOR DEFAULT *(Not applicable to privately financed public improvements)*

A. If the Contractor should be adjudged bankrupt, or if the Contractor should make a general assignment for the benefit of their creditors, or if a receiver should be appointed on account of insolvency, or if the Contractor should refuse to or fail to supply enough properly skilled workers, proper materials, or proper equipment for the efficient prosecution of the project, disregard laws, ordinances or the instructions of the City, or otherwise be in violation of any provision of the Contract Documents, the Manager may, without prejudice to any other right or remedy and after giving the Contractor and its surety seven (7) days written notice, terminate the services of the Contractor and take possession of the premises and of all materials, tools, and appliances thereon as well as all other materials whether on the premises or not, on which the Contractor has received partial payment, and finish the work by whatever method it may deem expedient.

B. In the event action as above indicated is taken by the City, the Contractor, or its surety, shall provide the City with immediate and peaceful possession of all of the materials, tools, and appliances located on the premises as well as all other materials whether on the premises or not, on which the Contractor has received any progress payment. Upon termination, in the event that the surety does not complete the Contract, at the election of the City, the Contractor shall assign any and all subcontracts and material contracts to the City or the City's designee. Further, the Contractor shall not be entitled to receive any further payment until the work is completed.

C. On completion of the work by the City, determination shall be made by the Project Manager of the total amount the Contractor would have been entitled to receive for the work, under the terms of the Contract, had the Contractor completed the work. If the difference between said total amount and the sum of all amounts previously paid to the Contractor, which difference will hereinafter be called the "unpaid balance," exceeds the expense incurred by the City in completing the work, including expense for additional managerial and administrative services, such excess will be paid to the Contractor, with the consent of the surety. If the expense incurred by the City exceeds the unpaid balance, the amount of the excess shall be paid to the City by the Contractor or its surety. The expense incurred by the City as herein provided, and the damage incurred through the Contractor's default, shall be as determined and certified by the Manager.

D. In addition to and apart from the above-mentioned right of the City to terminate the employment of the Contractor, the Contract may be canceled at the election of the City for any willful failure or refusal on the part of the Contractor to faithfully perform the Contract according to all of its terms and conditions; provided, however, that in the event the City should cancel the Contract, neither the Contractor nor its surety shall be relieved from damages or losses suffered by the City on account of the Contractor's breach of the Contract.

E. The City may, at its discretion, avail itself of any or all of the above rights or remedies and invoking of any one of the above rights or remedies by the City will not prejudice or preclude the City from subsequently invoking any other right or remedy set forth above or elsewhere in the Contract.

F. None of the foregoing provisions shall be construed to require the City to complete the work, to waive or in any way limit or modify the provisions of the Contract, including damages suffered by the City on account of the project not being completed within the time prescribed.

106.13 *TERMINATION IN THE PUBLIC INTEREST (Not applicable to privately financed public improvements)*

A. It is hereby agreed that the City has the right to terminate the Contract in whole or in part when it is considered to be in the public interest.

B. In the event the Contract is terminated as being in the public interest, the Contractor shall be entitled to a reasonable amount of compensation for preparatory work and for all costs and expenses arising out of the termination excluding lost profits.

The amount to be paid to the Contractor:

1. Shall be determined on the basis of the Contract price in the case of any fully completed separate item or portion of the work for which there is a separate lump sum or unit price; and

2. In respect to any other work, the Contractor will be paid a percent of the Contract price equal to the percentage of the work completed.

107 CONTROL OF WORK

107.01 *AUTHORITY OF THE PROJECT MANAGER AND ENGINEER*

A. The Project Manager will decide all questions that may arise as to quantity, quality, and acceptability of materials furnished and work performed, the rate of progress of the work; interpretation of the plans and specifications; the measurement of all quantities; and the acceptable fulfillment of the Contract Documents on the part of the Contractor. The Project Manager is not obligated to pay for quantities incorporated in the project in excess of quantities estimated in the schedule of prices unless the Project Manager or their designee has approved such overrun. The Project Manager's estimates, decisions, and approval signify favorable opinion and qualified consent; it does not carry with it certification or assurance of completeness, quality, or accuracy concerning details. Such approval does not relieve the Contractor from responsibility for errors, improper fabrication, improper construction methods, and non-conformance to requirements, or for deficiencies within their control.

B. All work to be done under the Contract Documents will not be considered completed until it has passed final inspection by the Engineer and is accepted by the Manager. It is further understood that the authority of the Engineer is such that the Contractor shall at all times carry out and fulfill the instructions and directions of the Engineer insofar as they concern the work to be done under the Contract Documents.

C. The Project Manager shall have the authority to order unacceptable work to be corrected, removed or replaced, and unauthorized work to be removed and, pending completion of such order, to deduct the estimated cost

thereof from any monies due, including retainage, or to become due the Contractor. This authority shall take precedence over any and all requirements for payment.

D. In the Engineer's sole discretion, minor defects in the work may be accepted. These may be subject to a reasonable deduction from the Contract price or other credits to the City. Such determination by the Engineer shall be final.

E. The Inspector, Project Manager or Engineer is not authorized to waive any written notice required of the Contractor by the Contract Documents.

107.02 AUTHORITY AND DUTIES OF INSPECTORS

A. The City may designate persons to inspect material used and all work done. Such inspection may extend to any or all parts of the work and to the preparation or manufacture of materials to be used. Inspectors are not authorized to change the provisions of the Contract Documents. An Inspector is placed on the work to keep the Project Manager informed of progress of the work and the manner in which it is being done. In addition, the Inspector shall call to the attention of the Contractor any deviation from the plans or specifications. An Inspector is not authorized to inspect, accept, or approve any changes to the work in the Contract Documents unless such changes have been previously approved by the City and the Engineer of Record.

B. An Inspector will not be authorized to approve or accept any portion of the work or to issue instructions contrary to the plans and specifications. Furthermore, the Inspector is not authorized to waive any written notices required by the Contract Documents. The Inspector will have authority to reject defective material and to suspend any work that is being improperly done, subject to final decision by the Engineer.

C. In instances where the Contractor did not afford the Inspector appropriate opportunity or notice to inspect, the Inspector may require the removal and replacement of the un-inspected item(s) at no expense to the City.

107.03 RESPONSIBILITY OF THE CONTRACTOR

A. Do all work and furnish all labor, materials, equipment, tools, and machines necessary for the performance and completion of the project in accordance with the Contract Documents. Be obligated to determine and be responsible for the method of construction.

B. The Contractor shall be solely liable for any accident, loss, or damage happening to work referred to in the Contract Documents prior to completion and acceptance thereof.

107.04 NOTIFICATION OF UTILITIES AND AGENCIES

A. Obtain prior approval from the Transportation Manager for closing or partial closing of any street. Give at least two working days advance notice of such closure to all agencies providing emergency services, including without limitation police, fire, and ambulance services. Notification shall include, but not be limited to, the time of commencement and completion of work, names of streets or location of alleys to be closed or partially closed, schedule of operations, and routes of detours where applicable.

B. When performing work in streets and easements, notify all of the affected utilities and local agencies about the operations so as to properly coordinate and expedite the work in such a manner as to cause the least amount of conflict and interference between the operations and those of other agencies.

C. The Contractor and its subcontractors must comply with all provisions of ORS 757.542 to 757.562 and 757.993 including notification of all owners of underground facilities at least forty-eight (48) business day hours but not more than ten (10) business days before beginning work. Notify the following utilities and agencies in writing at least 2 working days before commencing any work on the project:

City of Gresham: Stormwater Division
Transportation & Development Services Division
Wastewater Division (WWTP)
Water Division
Comcast (cable)
Electric Lightwave
Centennial School District
Gresham-Barlow School District
Reynolds School District
Multnomah County Traffic Engineering
Multnomah County Transportation Division
NW Natural (gas)
Oregon Department of Transportation (ODOT)
Pacific Power & Light Company
Portland General Electric Company
Portland Water Bureau
Powell Valley Water District
Qwest (telephone)
Rockwood Water District
Tri-Met (public transportation)
Verizon Northwest (telephone)

Such other utilities and agencies as identified by the City or the Contractor

D. The City, for publicly financed public improvement projects, shall relocate or cause to be relocated all privately or publicly owned utility conduits, lines, poles, mains, pipes, and such other facilities where such relocation is necessary in order to conform said utility and other facilities with the plans and ultimate requirements of the project. The Contractor, for privately financed public improvement projects, shall coordinate relocation of all privately or publicly owned utility conduits, lines, poles, mains, pipes, and such other facilities with the utility owner where such relocation is necessary in order to conform said utility and other facilities with the plans and ultimate requirements of the project.

107.05 UTILITIES AND EXISTING IMPROVEMENTS

A. Information shown on the plans as to location of utilities and associated appurtenances, existing improvements, and all topographical features is provided for the Contractor's information and convenience and is not in any way warranted to be accurate by the City. The Contractor shall verify all such information and shall deal with varying conditions at its own expense.

B. Operation of water valves and hydrants by unauthorized personnel is strictly prohibited. Obtain written permission from and pay any fee required from the water authority in whose jurisdiction the work is being performed prior to using hydrant water.

C. The Contractor is responsible to provide for the flow of sewers, drains, or watercourses interrupted during the progress of the work, and restore such drains or watercourses as approved by the Engineer at no additional cost to the City.

D. The Contractor is responsible for all costs for the repair of any and all damage to any utility, whether previously known or disclosed during the work, as may be caused by the work. Maintain in place utilities not shown on the drawings to be relocated or altered by others. If the Contractor requires temporary relocation, for convenience or because of a method of construction or as a result of site conditions, the Contractor shall bear all costs for said temporary relocation and must obtain the appropriate approvals from the City and the utility prior to relocation. Maintain utilities that have been relocated by others in their relocated positions in order to avoid interference with structures that cross the project work.

E. The Contractor must make excavations and borings ahead of work, as necessary, to determine the exact location of interfering utilities or underground structures. If the Contractor damages a utility, the utility owners shall have the right to enter upon the right-of-way and upon any structure therein for the purpose of making new installations, changes, or repairs. Conduct operations so as to provide the time needed for such work to be accomplished during the progress of the improvement, at no additional cost to the City.

F. It is understood that there will be interfering utilities, service laterals, and other underground pipes, drains, or structures encountered on underground projects that are not shown or are shown incorrectly on the plans and/or have not been previously discovered in the field. The Contractor agrees this is a normal and usual occurrence in the construction of underground improvements. Furthermore, the Contractor understands and agrees that work in some cases must be done in close proximity to said utilities and underground pipes, drains, and structures not shown or shown incorrectly on the plans which may require a change in operations and may cause sloughing of the trench, additional traffic control, additional excavation, backfill and restoration costs, and time. The Contractor agrees that these occurrences are usual and ordinary on underground projects and are reflected in the offer and construction schedule.

G. The Engineer will require a reasonable amount of time to perform design changes necessitated by directly conflicting utilities and/or the utility owners will require a reasonable amount of time to make necessary utility relocations.

H. The Contractor agrees to provide for these conflicts and interferences and agrees to provide for a reasonable amount of time for design changes and/or utility relocations due to said interference, that the cost of these conflicts and interferences has been incorporated into the offer, and Contractor understands that no additional compensation for interruption of schedule, extended overhead, delay, or any other impact claim or ripple effect or any other costs whatsoever or additional time will be made for these conflicts or interferences.

107.06 SURVEY SERVICE

A. For publicly financed public improvement projects, the Contractor shall give notice to the Project Manager not less than three working days in advance of when survey services will be required in connection with the laying out of any portion of the work.

B. The Engineer of Record will furnish and set construction stakes establishing lines and grades as determined necessary for all work under the Contract Documents. The Contractor will be responsible for maintaining the stakes provided to areas of work.

C. The Engineer of Record will furnish appropriate offset lines and grades as deemed necessary for all projects including those involving trenching operations. The Contractor will be responsible for the transfer of the offset lines or grades into the ditch, to batter boards, string lines, or any other point within the work. Work done without lines and grades having been established by the Engineer of Record or work done beyond the lines and grades will be considered as unauthorized and will not be paid for and may be ordered removed, replaced, or corrected at no expense to the City.

D. The Engineer of Record shall furnish cut sheets to the Inspector prior to construction of the facility.

E. Permanent property corners must be set prior to final inspection.

107.07 PROTECTION OF SURVEY MARKERS

A. Permanent Survey Markers

Notify the Engineer of Record not less than three working days prior to starting work in order that the Engineer of Record may take necessary measures to ensure the preservation of survey monuments, stakes, lot stakes, and benchmarks. Do not disturb permanent survey monuments, stakes, lot stakes, or benchmarks without the consent of the Engineer of Record. The Contractor shall bear the expense of replacing any that may be disturbed.

When a change is made in the finished elevation of the pavement of any roadway in which a permanent survey monument is located, preserve the monument and adjust the monument box to the new grade at no expense to the City.

B. Construction and Survey Markers

The Contractor shall preserve construction survey stakes and marks for the duration of their usefulness during construction. If any construction survey stakes are lost or disturbed during the work by the Contractor and its subcontractors and in the judgment of the Engineer need to be replaced, such replacement shall be by the Engineer of Record at no expense to the City. The cost of replacement may be charged against, and deducted from, payments for Contract work.

107.08 PROTECTION OF PROPERTY

The Contractor shall:

A. Protect all public and private property insofar as it may be endangered by operations, and take every reasonable precaution to avoid damage to such property.

B. Restore and bear the cost of any public or private improvement, facility, structure, or land and landscaping within the right-of-way or easement which is damaged or injured directly or indirectly by or on account of an act, omission, or neglect in the execution of the work. Restore to a condition substantially equivalent to that existing before such damage or injury occurred, by repairing, rebuilding, or otherwise effecting restoration thereof, or if this is not feasible, make a suitable settlement with the owner of the damaged property.

C. Give reasonable notice, typically 72 hours, to occupants of buildings on property adjacent to the work to permit the occupants to remove vehicles, trailers, and other possessions as well as salvage or relocate plants, trees, fences, sprinkler systems, or other improvements in the right-of-way which are designated for removal or which might be destroyed or damaged by work operations.

D. Protect all designated trees, lawns, and planted areas within the right-of-way or easements. Restore all on-surface, disturbed areas by methods as set forth in the Special Provisions. If conditions are such that the method specified cannot be done, provide erosion control surface covering of such quality and quantity as will prevent erosion from occurring, without adverse impacts to the environment, at no additional cost to the City.

E. Review with the Engineer of Record the location, limits, and methods to be used prior to clearing work. Clearing and grubbing shall be performed in strict compliance with all local, state, and federal laws and requirements pertaining to clearing and burning, and particularly in conformity with the provisions of ORS Chapter 477, and all subsequent amendments, which require, among other things, filing with the State Forester a general description of the right-of-way to be cleared before the start of clearing operations. Obtain the required permit from the State Forester and perform clearing work in conformance thereto.

107.09 RIGHTS-OF-WAY, EASEMENTS, AND PREMISES

Confine construction activities within property lines, rights-of-way, limits of easements, and limits of permits as shown or specified in the Contract Documents unless arrangements are made with the owner(s) of adjacent private property. If additional space or property is needed to accommodate the Contractor's method for construction of the work or for the convenience of the Contractor, the Contractor shall bear all related costs and responsibilities. Prior to the use of any private property outside the specified boundaries, submit to the Project Manager written permission from the property owner(s).

Do not unreasonably encumber the specified work areas with materials and equipment. Obtain and bear the costs of permits for special occupancy and use of the specified work areas from the proper agencies. Comply with all requirements regarding signs, advertisements, fires, and smoking.

107.10 USE OF WORK DURING CONSTRUCTION

A. The City shall have the right to take possession of and use any completed or partially completed portions of the work. Such use shall not be considered as acceptance of the work or portions thereof.

B. Such action by the City will not relieve the Contractor of responsibility for injury or damage to said completed portions of the work resulting from use by public traffic, action of the elements, the Contractor's operations, defective work, or negligence, or from any other cause, except for injury or damage resulting from the City's negligence. The Contractor will not be required to again clean up such portions of the work prior to final acceptance, excepting for such clean up as results from the Contractor's operations or defective work. Use of any completed or partially completed portions of the work does not relieve the Contractor from the warranty responsibility nor shall the warranty period commence to run until final completion and acceptance of the work.

107.11 FURNISHING TEMPORARY SERVICES AND FACILITIES

When necessary or when directed by the Engineer, install, furnish, and maintain temporary light, power, water, and any temporary services or facilities complete with connecting piping, wiring, lamps, and similar equipment during construction of the work, including testing and start up. Remove temporary facilities upon completion of work. Obtain all permits and bear all costs in connection with temporary services and facilities. Conform to applicable statutes, rules, codes, and other requirements in the use of these facilities.

107.12 VERBAL AGREEMENTS OR REPRESENTATIONS

No verbal agreement or conversation by or with any officer, agent, or employee of the City, either before or after execution of the Contract, shall affect or modify any of the terms or obligations contained in any of the Contract Documents. Any such verbal agreement or conversation is in no way binding upon the City.

107.13 WATER AND AIR POLLUTION CONTROL

A. During performance of the work, the Contractor's operations shall conform to applicable laws of the state and Federal Government and regulations of the Oregon Department of Environmental Quality, other agencies of the state and Federal Government, the City of Gresham's Erosion Prevention and Sediment Control Manual, as well as other local ordinances and resolutions designed to prevent, control, and abate water and air pollution.

B. During all phases of the work, protect work sites, storage, and disposal areas from washout and erosion, and take precautions to control or abate dust nuisance and air pollution by cleaning up, sweeping, sprinkling, covering, enclosing, or sheltering work areas and stockpiles, and by promptly removing from paved streets earth or other material which may become airborne or may be washed into waterways or drainage systems.

107.14 NOISE

Conform and comply with applicable noise regulations as established in GRC, Article 7.20.

107.15 ACCESS TO THE WORK

A. Provide access to the work for representatives of the City, the State of Oregon, the Federal Government, and other entities having jurisdiction in the area.

B. Allow access to the Project Manager, Engineer, and Inspector and their representatives to all parts of the work at all times and coordinate access to plants of manufacturers. Furnish them with every reasonable facility for ascertaining if the work meets requirements and intent of the Contract Documents

C. It shall be the duty of the Contractor to cause the work to remain accessible and exposed for inspection purposes. The City shall not be liable for expense entailed in the removal or replacement of any material required to allow inspection.

107.16 DEFECTIVE OR UNAUTHORIZED WORK

A. All work that does not conform to the requirements of the Contract Documents shall be considered as unacceptable.

B. Upon discovery, immediately remove unacceptable and defective work and replace by work and materials that conform to the Contract Documents. This provision shall have full effect regardless of the fact that the unacceptable work may have been done or the defective materials used with the full knowledge of the Inspector.

C. Work that cannot be inspected due to subsequent work may be deemed unacceptable and the subsequent work shall be removed at the Contractors expense if:

1) The Inspector had directed that the subsequent work not be done until the original work was inspected, or

2) The Inspector reasonably believes that the original work may be unacceptable.

D. If the subsequent work was done with the full knowledge of the Inspector and the Inspector did not direct that the subsequent work not be done until the original work was inspected, the City shall pay the cost of removal of the subsequent work if the original work conforms to the requirements of the Contract Documents.

107.17 RAILROAD CROSSINGS OR RIGHT-OF-WAY

Submit a schedule of proposed operations to the Project Manager whenever work involves the crossing of any railroad line or the encroachment on any railroad right-of-way. The schedule shall be approved by the appropriate railroad officials and the Project Manager before the work is started within such area. Pay for services of flag persons and/or watch persons furnished by the railroad company and provide and drive piling, set cribbing, build bridges or tunnels, install enclosing pipe, and do all other work required by the railroad company or necessary for safety or maintenance of railroad traffic, including working on weekends, holidays, and providing extra shifts. Furnish any bond or insurance required by the railroad company as a result of such intended operations and indemnify the City for any and all expenses incurred by the City, and assume any and all liability or claims thereof imposed on the City as a result of operations in railroad right-of-way area. Bear all costs resulting from interferences, obstructions, or liabilities set forth in this subsection, whether or not herein specifically mentioned.

108 CONTROL OF MATERIALS

108.01 PREFERENCE FOR USE OF OREGON PRODUCTS *(Not applicable to privately financed public improvements)*

Preference may be given to materials produced or manufactured in Oregon, if price, fitness, availability, and quality are otherwise equal. These provisions do not apply to contracts on projects financed wholly or in part by federal funds.

108.02 QUALITY OF WORK

Materials, parts, products, and equipment that are to be incorporated into the work shall be new and shall conform to the Contract Documents.

108.03 SAMPLING AND TESTING

A. Tests of the work may be made by the City at any time during construction of the work or during the production, fabrication, or preparation and use of materials, parts, products and equipment.

B. The City reserves the right to require samples and to test materials, parts, products, and equipment for compliance with pertinent requirements irrespective of prior certification of the materials, parts, products, and equipment by the manufacturer.

C. When such tests of the work are necessary as determined by the Project Manager, such tests will be made by the City at the Contractor's expense unless otherwise specified. Provide such facilities and cooperate as required for collecting and forwarding samples and do not incorporate into the work until tests have been made and found acceptable to the Project Manager. In all cases furnish the required samples without charge and in ample time to permit testing prior to use. Provide safety measures and devices to protect those who take the samples.

D. In the absence of any reference in the specification, it shall be understood that construction materials shall meet the specifications and the requirements of the American Society for Testing and Materials (ASTM), the American Association of State Highway and Transportation Officials (AASHTO), or the Standard Specifications for Construction (ODOT/APWA), as directed by the Engineer. When there is no pertinent coverage under ASTM, AASHTO or ODOT, the material concerned shall meet specifications and the requirements of applicable Commercial Standards of the Commodity Standards Division of the U.S. Department of Commerce. Lacking such coverage, materials shall meet requirements established by reputable industry for a high-quality product of the kind involved.

E. All testing shall be performed by the Engineer, a testing laboratory selected by the City, or as directed by the Engineer.

F. In the event that a Special Provision requires testing at the City's expense and the work fails, the Contractor shall bear all costs for all subsequent testing necessary to meet specified requirements.

108.04 CERTIFICATION

The Engineer, at his/her sole discretion, may, in lieu of any other required sampling and testing, accept from the Contractor two copies of the manufacturer's certification with respect to the product involved, under conditions set forth as follows:

1. Certification shall state that the named product conforms to the City's requirements and that representative samples thereof have been sampled and tested as specified.
2. Certification shall either be accompanied with a certified copy of test results, or certify that such test results are on file with the manufacturer and will be furnished to the Engineer upon request.
3. Certification shall give the name and address of the manufacturer and the testing agency and the date of tests; and shall set forth the means of identification which will permit field determination of the product delivered to the project as being the product covered by the certification.
4. Neither the Contractor nor the City shall be responsible for any costs of certification or for any costs of the sampling and testing of products in connection therewith.

108.05 INSPECTION BY OTHERS

Inspection of work by persons other than duly designated representatives of the City will not constitute inspection by the City.

108.06 STORAGE AND PROTECTION OF ITEMS OF WORK

Store items to be incorporated into the work to assure the preservation of their quality and fitness for the work. Stored items, even though approved before storage, may be re-inspected and are subject to rejection prior to being incorporated into the work. Stored items shall be located so as to facilitate their prompt inspection.

108.07 *TRADE NAMES, EQUALS, OR SUBSTITUTIONS*

A. In order to establish a basis of quality, certain processes, types of machinery or equipment, or kinds of materials may be specified either by description of process or by designating a manufacturer by name and referring to a brand or product designation or by specifying a kind of material. Generally it is not the intent of the specifications to exclude other processes, equipment, or materials of equal value, utility or merit.

B. Whenever a process is designated or a manufacturer's name, brand, or item designation is given or whenever a process or material covered by patent is designated or described with the words "or equal" following such name, designation, or description, submittals for other processes, types of machinery or equipment, or kinds of materials may be submitted to the Engineer for evaluation. This "or equal" clause is not a warranty by the City, either expressed or implied, that an equal exists.

C. The Contractor may offer to furnish materials or equipment of equal or better quality and performance other than that specified as a substitute after the Contract is executed. If the offer necessitates changes to or coordination with any other portion of the work, the data submitted shall include drawings and details showing all such changes. The Contractor agrees to perform these changes as part of the substitution of material or equipment. Acceptance by the Engineer shall not relieve the Contractor from full responsibility for the efficiency, sufficiency, quality and performance of the substituted material or equipment in the same manner and degree as the material and equipment specified by name. For publicly financed public improvement projects, any cost differential associated with a substitution shall be reflected in the Contract Price and the Contract shall be appropriately modified by Change Order as approved by the Project Manager.

D. If the Contract Documents includes a list of equipment, materials or articles for which the Contractor must name the manufacturer at time of submission of the offer, no substitutions therefore will be permitted unless approved in writing at the sole discretion of the Engineer.

E. All approved materials or equipment of equal or better quality offered by the Contractor for substituting shall be approved by the Engineer prior to incorporation into the project.

109 MEASUREMENT AND PAYMENT

(Not applicable to privately financed public improvements)

109.01 *MEASUREMENT OF QUANTITIES*

A. Payments shall be based on measurements of completed work in accordance with the United States Standard Measures and as set forth in the specifications.

B. Volume of materials measured in the vehicles by which they are transported will require computing of the volume of the vehicles to the nearest 0.1 cubic yard for its approved capacity, and identification of the vehicle and its capacity. Pay quantities will be determined by vehicle measurement at point of delivery with no allowance for settlement of material during transit.

Loads shall be level and uniform. Payment will not be made for material in excess of the approved capacity of the vehicle and deductions will be made for loads below approved capacity.

C. Volume of concrete and masonry in structures will be measured according to neat lines as shown on the plans or as altered on order of the Engineer of Record.

D. Volume of earthwork, particularly excavation and embankment, will be computed by the average end area method or by other methods of equivalent accuracy.

E. Weight – When payment for materials other than bituminous cements is on a weight basis and unless otherwise set forth in the specification under which material is to be furnished, pay quantities will be determined by weighing material on weigh scales provided by the Contractor as set forth hereinafter. Such weighing is to be of material in the hauling vehicle as loaded for delivery. Determination of tare weights and weight of loaded vehicles will be to the nearest ten (10) pounds. Tare weights will be determined by weighing empty vehicles at intervals of such frequency as the Engineer deems necessary to ensure accuracy of payload weights.

F. Scales – When the Contract Documents call for materials that are to be measured by weighing on scales, the Contractor shall provide suitable scales and transport materials to scales at no expense to the City. Before use of scales is commenced, and as frequently as the Engineer may deem necessary to ensure accuracy, have the scales examined by an official of the Oregon Department of Agricultural Measurement Standards Division, and bear all resulting costs. Maintain the scales in accurate condition at all times.

G. Furnish and locate scales so that the amount of hauling involved in the delivering of materials is no greater than if no weighing were required; if not, bear expense of whatever extra hauling is required. If hauling of materials is to be paid for as a separate pay item, the distance shall be via the most direct practicable route and no allowance will be made for any extra hauling required to reach the scales.

H. A representative of the City may be present at all times to witness the weighing and to check and compile records of scale weights.

109.02 SCOPE OF PAYMENT

A. Quantities listed in the schedule of prices do not govern final payment. Payments to the Contractor will be made only for actual quantities of items performed in accordance with terms of the Contract and for items of work actually performed under change orders.

B. The City certifies that sufficient funds have been appropriated to make payments required by the Contract during the fiscal year the Contract was executed by the City. Payment for work performed after June 30 of any given year is subject to funds being appropriated by the Gresham City Council. If funds are not appropriated, the City may terminate the Contract by notice to the Contractor.

109.03 COMPENSATION FOR ALTERATION OF THE CONTRACT

A. Unless changes and alterations in the Plans, Specifications, or quantities, or details of construction materially change the character of the work to be performed or the unit price thereof, the Contractor shall accept as payment in full, so far as Contract items are concerned, payment at the same unit prices as are provided under the Contract for the accepted quantities of work done. If the Contract is done on a lump sum basis, the adjustment for increases or decreases may be based, at the sole discretion of the Project Manager, on a theoretical unit price. The price will be determined by dividing the Contractor's applicable breakdown category price (as listed in the Special Specifications or as set forth in the Bid) by the estimated quantities of all units of work within the applicable breakdown category.

B. If either (1) the total cost of the work, using actual quantities and unit prices, or (2) the total quantity of any major contract item, using actual quantities, changes more than 25%, then that part of the increase or decrease exceeding 25 percent shall be adjusted as the parties agree. A major item is any contract item, except lump sum items, having an actual cost greater than 10% of the contract price. If the parties cannot agree, the Project Manager will determine the equitable adjustment of time, payment, or both. The basis of the equitable adjustment of time will be in accordance with **Subsection 106.07**. The basis of the equitable cost adjustment for decreases will take into account a redistribution of fixed costs. The basis of the equitable cost adjustment for increases will be by using one of the following methods:

1. Unit prices
2. Other means of establishing costs
3. Force account

C. The Contractor shall obtain written consent of the surety or sureties if: (1) changed work increases the total cost by more than 25% of the original total contract price, or (2) the Project Manager requests such consent.

D. The City will not adjust for increases or decreases in quantities if the City has entered the quantity of an item in the schedule of prices only to provide a common basis for Bidders. The Contractor shall bear all costs that result from such increases or decreases.

109.04 PAYMENT FOR CHANGE ORDERS

A. Payment or credit for any alterations covered by a change order shall be determined by one or a combination of the methods set forth in 1, 2, 3, or 4 below.

B. Any request for quotations on alterations to the work shall not be considered authorization to proceed with the work prior to the issuance of a formal change order, nor shall such request justify any delay in existing work. Lump sum quotations for alterations to the work shall include substantiating documentation with an itemized breakdown of the Contractor and subcontractor costs, including labor, material, rentals, and approved services, overhead, and profit calculated as specified under method "3".

C. In methods "1" and "2", the Contractor's quotations for change orders shall be in writing and firm for a period of thirty (30) days. Any compensation paid in conjunction with the terms of a change order shall comprise total compensation due the Contractor for the work or alteration defined in the change order. By signing the change order, the Contractor acknowledges that the stipulated compensation includes payment for the work or alteration plus all payment for the interruption of schedules, extended overhead, delay, or any other impact claim or ripple effect, and by such signing specifically waives any reservation or claim for additional compensation or time in respect to the subject of the change order.

D. Payment Methods

1. **METHOD 1 – UNIT PRICES:** If applicable, those unit prices stipulated in the offer, or unit prices negotiated and mutually acceptable to the Contractor and the Project Manager.

2. **METHOD 2 – LUMP SUM:** A total sum for the work negotiated and mutually acceptable to the Contractor and the Project Manager.

3. METHOD 3 – FORCE ACCOUNT WORK:

a. The Contractor shall perform work on a force account basis upon written notice from the Project Manager. Payment will be made as set forth herein.

b. The Contractor must maintain records in such a manner as to provide a clear distinction between direct cost of work performed on force account basis and costs of all other operations performed in connection with the Contract.

c. Daily, furnish to the Project Manager signed reports itemizing materials used and setting forth the cost of labor and charges for equipment rental, delineating whether said equipment is Contractor or Subcontractor owned. Provide names, identifications, and classifications of workmen, the hourly rate of pay and hours worked, and the size, type and identification number of equipment and hours of equipment operation. Substantiate material charges by vendor's invoices, submit such invoices with the reports; or, if not available, submit with subsequent reports. In the event said vendor's invoices are not submitted within 45 days after completion of the force account work, the City reserves the right to establish the cost of such materials.

d. The Project Manager will review the records and reports furnished by the Contractor, make any necessary adjustments, compile the costs of work paid for on a force account basis and issue a change order covering the work.

e. When work is ordered to be paid for on a force account basis, such work will be paid for on the basis of cost, plus a negotiated percentage allowance, not to exceed the maximum set forth herein.

f. Items of cost for which payment will be made and to which payment will be restricted, together with the maximum percentage allowance applicable to the respective items, are as follows:

Items of Cost for Which Payment Will Be Made	Maximum Percentage Additional Allowance To Actual Costs
Labor, while engaged directly on force account work	20
Materials and supplies used on force account work	15
Rental on equipment having a value in excess of \$300	No allowance except as provided in (i) to (l) below

g. Payment for labor used in the work will be computed at the rates actually paid by the Contractor, but not to exceed prevailing straight time rates established by the Oregon Bureau of Labor and Industries, plus allowable allowance set forth above. Time allowed shall be the number of hours worked directly on force account operations. The employer's cost for accident and unemployment compensation premiums, labor insurance cost, public liability and property damage insurance costs and fringe benefits will be included in the direct labor cost item before applying the additional allowance. Any overtime worked on force account operations will be compensated at the straight time rates unless previous approval was obtained from the Project Manager.

h. Payment for materials and supplies used on force account work must be supported by paid invoices. The Contractor and subcontractors shall take advantage of all practicable discounts on bills for materials and supplies, and such discounts shall be reflected on all bills and invoices submitted to the City for payment. Freight will be considered to be part of the cost of materials and supplies and will be paid for as materials and supplies. Materials and supplies will be paid for as agreed in writing prior to their production or use. If there is no price agreement, the Project Manager shall establish a reasonable price for such materials and supplies.

i. For the use of the Contractor's equipment, the Contractor will be paid at the monthly rental rates and the hourly operating costs set forth in the current edition of the "Rental Rate Blue Book for Construction Equipment" and the "Rental Rate Blue Book for Older Construction Equipment" which are published by the Equipment Guidebook Company, 2800 W. Bayshore Road, Palo Alto, California 94303. Reference copies of the above publications are on file at the Oregon Department of Transportation and the area offices of the Associated General Contractors of America. While using the Blue Book to determine allowable rental rates for equipment, the hourly rate will be calculated by using the monthly rate as set forth in the book, divided by one hundred seventy-six (176) hours. The rental rates will be the total compensation for all costs including fuel, supplies, repairs, and renewals. No further allowance will be made for these items. For the use of equipment not listed in said documents, the rental rates shall be as agreed to in writing between the Contractor and the Project Manager prior to use of said unlisted equipment. If there is no prior agreement, the Project Manager shall establish a reasonable price for such equipment.

j. Time allowed for the Contractor's equipment shall be only the number of hours that the equipment actually operated directly on force account work.

k. Compensation on equipment not owned by the Contractor will not exceed the rates actually paid by the Contractor and must be supported with an invoice that represents an arm's length transaction. The Contractor and the Project Manager will agree on the equipment to be used and the appropriate rental rates before using said equipment on force account work. If prior approval is not obtained, the Project Manager will establish the rates by either comparing the available equipment and using the applicable rate for the least expensive equipment that will accomplish the work, or utilizing the applicable Blue Book rates as established above. Rental cost for equipment not owned by the Contractor will be established so as to minimize the cost to the City. The hourly rate will be used unless the accumulated cost using the hourly rate exceeds the accumulated cost using the daily rate. The daily rate will be used unless the accumulated cost using the daily rate exceeds the accumulated cost using the weekly rate. This system will be expanded to utilize monthly or yearly rates as appropriate. These rental rates will be considered total compensation for all costs, including move-in, move-out, fuel, supplies, repairs, and renewals. No further allowance will be made for these items without specific approval of the Project Manager before the work is commenced. Payment for rental on equipment not owned by the Contractor shall be at the rental costs so determined, plus a negotiated percentage not to exceed the allowance for materials and supplies.

l. Individual pieces of equipment having a value of \$350 or less will be considered to be tools or small equipment, and no rental will be allowed on such, unless not normally on work site and must be rented from others. Then (k) will apply.

m. No standby charges will be considered as a compensable part of any force account work. When a piece of equipment and operators thereof are hired, rented, or furnished as a unit, (owner/operator), the additional percentage to be allowed shall be five (5) percent and the Contractor shall not be entitled to twenty (20) percent on the time of operators of such equipment. Neither shall the Contractor be entitled to payment for contributions made under terms of the Worker's Compensation Act, Unemployment Compensation Act, or Social Security Act or any other benefits to cover the time of these operators.

n. The percentage allowances made to the Contractor in accordance with terms outlined herein will be full reimbursement and compensation for all supervision, use of tools and small equipment, overhead expense, bond costs, record keeping expense, insurance premiums, profits, indirect costs, and all other items of cost not specifically designated herein as items for which payment is to be made, whether or not the services, costs, and other items involved are furnished or incurred by the Contractor or subcontractor.

o. When work is performed on a force account basis by a subcontractor, the Contractor will be allowed a supplemental markup of 5% on amount charged by subcontractor, provided the City will pay no more than a reasonable amount for work performed by a subcontractor.

4. METHOD 4 – PAYMENT DETERMINED BY THE PROJECT MANAGER:

In case no other basis can be agreed upon and the Project Manager has not directed the work to be paid for on a force account basis, then an allowance may be made, either for or against the Contractor, in such amount as the Project Manager may determine to be fair and equitable.

109.05 CLAIMS AND NOTICE

A. No claim shall be made by the Contractor for any loss of anticipated profits because of any alterations or changes made pursuant to the provisions of **Subsections 105.04 and 109.04**, nor by reason of any variation between the approximate quantities and the quantities of work as done. Unless specifically authorized in **Subsection 109.04**, no allowance will be made for any increased expense, loss of expected reimbursement or loss of anticipated profits suffered or claimed by the Contractor resulting directly from such alterations or changes or resulting indirectly from unbalanced allocation of overhead expense among the Contract items by the Contractor in its offer and subsequent loss of expected reimbursements therefore or from any other cause.

B. In any case where the Contractor claims that he/she is entitled to or will be entitled to additional compensation and/or additional Contract time, the Contractor shall notify the Project Manager, in writing, of their intention to make a claim within 5-days of the occurrence of the event giving rise to the claim. If the Contractor considers any interpretation or order by the Project Manager to require additional compensation or contract time, or is a breach of the Contract, the Contractor shall notify the Project Manager prior to beginning the work or conforming to the interpretation on which the claim is based. The Contractor's written notification shall be a written statement describing (1) the event or the act of omission or commission by the City or its agent that allegedly caused damage to the Contractor, (2) the nature of the claimed damage, (3) the clauses of the Contract or general legal principles upon which the claim is based, and (4) the factual occurrences upon which the Contractor bases the claim. Submission of notice of claim as specified shall be mandatory, and failure to comply shall be a conclusive waiver to such claim for damages by the Contractor. Oral notice will not be sufficient nor will notice after the specified time period since it tends to hinder, if not prevent, the City's investigation of the pertinent facts. After said written notification (if the claim is not resolved or withdrawn in writing) and only upon written direction by the Project Manager, proceed without delay to perform the work pursuant to the decision of the Project Manager. While the work on an unresolved claim is being performed, the Contractor shall keep track of costs and maintain records in the manner set forth in **Subsection 109.04(A)(3) FORCE ACCOUNT WORK**, at no cost to the City. Such notice by the Contractor and the fact that the Contractor and the Project Manager are keeping track of costs and maintaining records as required by **Subsection 109.04(A)(3) FORCE ACCOUNT WORK** shall not in any way be construed as proving the validity of the claim or the costs thereof.

C. A fully documented claims package shall be submitted in writing to the Project Manager within forty-five (45) days after completion of the work or the occurrence of the event upon which the claim is based.

D. Each claim submitted shall include substantiating documentation with an itemized breakdown of the Contractor's and subcontractor's costs on a daily basis that shall include, but not be limited to, labor, material, equipment, supplies, services, overhead, and profit. All documentation that the Contractor believes is relevant to the claim shall be provided in said claim package including without limitation payroll records, purchase orders, quotations, invoices, estimates, profit and loss statements, daily logs, ledgers, and journals. The Project Manager may request from the Contractor additional documentation relating to the claim at any time during the Project Manager's investigation of the claim. Failure to submit the claim package in full compliance with this requirement, and/or maintain cost records as herein required, will constitute a waiver of the claim.

E. The requirements of this subsection shall apply to claims for additional or extra compensation or time arising from any situation that may occur except for claims of error in the final estimate as provided in **Subsection 109.08**.

F. Provided the claim or claims have been submitted in accordance with the requirements of this subsection, the Project Manager will, as soon as possible, consider and investigate the claim or claims of the Contractor for additional compensation. The Project Manager will promptly advise the Contractor of the decision to accept or reject the claim or claims, in full or in part.

G. The Contractor shall commence any suit or action to collect or enforce any claim filed in accordance with this subsection within a period of one year following the mailing of the Project Manager's full or partial denial. If said suit is not commenced in said one-year period, the Contractor expressly waives any and all claims for additional compensation and any and all causes of suit for the enforcement thereof that the Contractor might have had.

109.06 THE CITY'S RIGHT TO ACCESS TO THE CONTRACTOR'S RECORDS

A. In the event that the Contractor makes a claim under **Subsection 109.05** or performs force account work under **Subsection 105.05**, the City or its designated representative shall have access and a right (at any time) to inspect, audit, and copy the Contractor's books, records, documents, diaries, and logs and other evidence (hereinafter referred to as records) pertinent to performance and payment of the Contract and amendments, change orders, and any claims made in relation to the Contract. If an audit is conducted, it shall be in accordance with generally accepted auditing standards.

B. The Contractor will make its records available within the boundaries of the City of Gresham, Oregon, or pay all additional costs for travel and per diem or other additional expenses incurred by the City in examining, auditing, inspecting, and copying the Contractor's records, by reason of said records not being available within said boundaries.

C. The Contractor agrees to the disclosure of all records and to their admission as evidence in any proceeding between the parties involving a claim or force account work.

D. In the event that the Contractor's records establish a discrepancy, favorable to the City, in the representations the Contractor has made to the City involving claims or force account work, the Contractor shall bear all costs incurred by the City in conducting the audit and inspection provided herein.

E. All costs referenced in subparagraphs "B" and "D" may be withheld and/or deducted from any amount due or that becomes due the Contractor.

109.07 PROGRESS PAYMENTS AND RETAINAGE

A. Payment for all work under the Contract will be made at the price or prices offered, and those prices shall include full compensation for all incidental work.

B. If the Contract is for a public work and the contract price is \$25,000 or more, supply and file, and require every subcontractor to supply and file, with the Project Manager a statement in writing that conforms to the requirements of ORS 279C.845.

C. Make progress estimates of work performed in any calendar month and submit to the Project Manager for approval, before the fifth of the following month, or as mutually agreed between the Contractor and the Project Manager. These estimates shall include value of labor performed and materials incorporated in the work since commencing work under the Contract. Such estimates need not be made by strict measurements and may be approximate only, and shall be based upon the whole amount of money that will become due according to terms of the Contract when the project has been completed.

i. The Project Manager may include in payments 85% of the cost to the Contractor of materials or equipment not yet incorporated in the work but delivered and suitably stored at the site, or at some other location agreed upon in writing.

ii. Such a payment shall be conditioned upon submission by the Contractor of bills of sale or such other documentation satisfactory to the Attorney to establish the City's title to such materials or equipment or otherwise protect the City's interest including applicable insurance and transportation to the site, and a statement from the Contractor explaining why it is necessary to procure said equipment and/or materials.

iii. When such payments are made, the Contractor warrants and guarantees that the title to all materials and equipment covered by a progress payment, whether incorporated in the project or not, will pass to the City upon receipt of such payment by the Contractor, free and clear of all liens, claims, security interests, or encumbrances.

D. If the contract price is determined, in whole or in part, on a lump sum basis, prepare an itemized cost breakdown relating thereto and have the Project Manager approve it before commencing work; progress estimates based on said itemized cost breakdown may be the basis for progress payments. Upon direction by the Project Manager provide for revision of the costs breakdown to reflect the true costs of the work as it progresses.

E. If the contract price is determined wholly on a unit price basis, the Project Manager may use the unit prices in making progress estimates on the work. In case said unit prices do not, in the opinion of the Project Manager, truly represent actual relative costs of different parts of work, a percentage of the unit price may be used in making progress estimate adjustments.

F. If the Project Manager receives written notice of any unsettled claims for damage or other costs due to the Contractor's operations including, without limitation, claims from any City department or other governmental agency, an amount equal to the claim may be withheld from the progress payments, final payments, or retainage until such claim has been resolved to the satisfaction of the Project Manager.

G. Progress payments will be made by the City on a monthly basis within thirty (30) days from sign-off by the Contractor of the progress payment or fifteen (15) days after the payment is approved by the Project Manager of work performed. Payment will be issued by the City for the amount of the approved estimate, less 5% retainage. Such amount of retainage shall be withheld and retained by the City until it is included in and paid to the Contractor as part of the final payment of the Contract Price. Securities in lieu of retainage will be accepted, or if the Contractor elects, retainage as accumulated will be deposited by the City in an interest-bearing account pursuant to ORS 279C.570. Upon substantial completion of the work under the Contract which shall be understood to be not less than 97.5% of the work, the Project Manager may, at his/her discretion, reduce the retained amount equivalent to not less than 200% of the balance of the contract price or the estimated value or estimated cost, whichever is greater, of the work remaining to be done.

H. The Project Manager may decline to approve an application for payment and may withhold such approval if, in the Project Manager's opinion, the work has not progressed to the point indicated by the Contractor's submittal. The Project Manager may also decline to approve an application for payment or may reduce said payment or, because of subsequently discovered evidence or subsequent inspections, the Project Manager may nullify the whole or any part of any payment previously made to such extents as may be necessary in their opinion to protect the City from loss because of: (1) defective work not remedied, (2) third party claims filed or failure of the Contractor to make payments properly to subcontractors for labor, materials, or equipment, unless surety consents to such payment,

(3) reasonable doubt that the work can be completed for the unpaid balance of the contract price, (4) damage to another contractor's work, (5) reasonable indication that the work will not be completed within the contract time, (6) unsatisfactory prosecution of the work by the Contractor, (7) claims against the Contractor by the City, (8) failure to submit a construction schedule or failure to keep said construction schedule updated as set forth in **Subsection 106.01**, or (9) exceeding work limits as set forth in **Subsection 206.03**.

I. When any or all of the criteria set forth above have been remedied satisfactorily to the Project Manager, payment shall be made for amounts withheld because of them. Withholding of progress payments or partial payments under the criteria set forth above shall not entitle the Contractor to interest on such withheld payments or partial payments.

J. If the Contractor fails to complete the project within the time limit fixed in the Contract or any extension, no further estimate may be accepted or progress or other payments allowed until the project is completed, unless approved otherwise by the Manager.

K. Progress estimates are for the sole purpose of determining progress payments and are not to be relied on for any other purpose. The making of a progress payment shall not be construed as an acceptance of any of the work or materials under the Contract.

L. When the progress estimate indicates that the progress payment would be less than \$1,000, no progress payment will be made for that estimate period, unless approved by the Project Manager.

109.08 COMPLETION, FINAL PAY ESTIMATE, AND FINAL PAYMENT

A. **SUBSTANTIAL COMPLETION:** The Contractor shall notify the Project Manager in writing when all or a portion of the work is considered substantially complete. If it appears to the Project Manager that the work is not substantially complete, the Project Manager shall not authorize an inspection. The Project Manager may provide a general list of major work components remaining before inspection will be authorized.

If it appears that the work is substantially complete, the Project Manager shall, within fifteen (15) days after receiving notice, authorize an inspection and determine if the work is substantially complete. If the work is not substantially complete, the Project Manager shall notify the Contractor of the work that must be performed prior to requesting another inspection.

If substantially complete, the Project Manager shall prepare a Certificate of Substantial Completion. The certificate will include a general list of items remaining to be completed. The date of substantial completion of all the work shall stop the accrual of liquidated damages, if applicable.

After acceptance of the Certificate of Substantial Completion by both parties, the City may elect to begin using the work. If the City so elects, the City shall be responsible for operation and maintenance of the work utilized. Contractor shall continue to be responsible for the warranty requirements of **Subsection 103.15**, protection of the work as required by **Subsection 107.08**, and all other applicable terms of the Contract

B. **FINAL COMPLETION:** Notify the Project Manager in writing when work is 100% complete. If it appears to the Project Manager that the work is not 100% complete, the Project Manager shall not authorize a final inspection. The Project Manager may provide a general list of major work components remaining. If it appears that the work is 100% complete, the Project Manager shall, within fifteen (15) days after receiving notice, authorize a final inspection and either accept the work or notify the Contractor of work yet to be performed.

If the work is 100% complete, the Project Manager shall prepare a final pay estimate and Certificate of Final Completion accepting the work as of a certain date. A Certificate of Final Completion shall not be prepared until all provisions of the Contract have been met, including but not limited to, the submission by the Contractor of a signed Certificate of Compliance and Contractor Race/Gender Summary Sheet. The Contractor shall execute and return the final pay estimate and Certificate of Final Completion within five (5) working days of receipt. Unless otherwise provided as a Special Provision, when the Manager accepts the Certificate of Final Completion, the date the Contractor signs the Certificate of Final Completion shall be the date the City accepts ownership of the work and the start date of the two (2) year warranty period.

The Project Manager shall include in the final pay estimate an addition to the contract price for any contract incentive or a deduction from the contract price for any liquidated damages and a deduction from the contract price in a fair and equitable amount for any damages to the City or for any costs incurred or likely to be incurred by the City due to the Contractor's failure to meet any plan or specification other than timely completion.

C. If the Contractor believes the quantities and amounts specified in the final pay estimate prepared by the Project Manager to be incorrect, the Contractor shall submit to the Project Manager within five (5) working days of receipt of the Project Manager's final pay estimate, an itemized statement of any and all claims for additional compensation under the Contract which are based on differences in measurements or errors of computation. Any such claim not so submitted and supported by an itemized statement within said period is expressly waived and the City shall not be obligated to pay the same. Nothing contained herein shall limit the requirements of **Subsection 109.05**.

D. The Contractor shall commence any suit or action to collect or enforce the claim or claims for any additional compensation arising from errors of computation in the final estimate within a period of one (1) year following the original mailing of the Project Manager's final estimate and Certificate of Final Completion to the Contractor's last known address as shown in the records of the Project Manager. The Project Manager's issuance of a revised final estimate pursuant to this subsection does not alter the original final estimate date. If said suit, action, or proceeding is not commenced in said one (1) year period, the final estimate and Certificate of Final Completion or revised final estimate and Certificate of Final Completion, if revisions are made, shall be conclusive with respect to the amount earned by the Contractor, and the Contractor expressly waives any and all claims for compensation and any and all causes of suit or action for the enforcement thereof that the Contractor might have had.

E. Upon return of the fully executed Certificate of Final Completion from the Contractor, the Project Manager will submit the Certificate of Final Completion and final estimate to the Manager for approval. Upon approval and acceptance by the Manager, the Contractor will be paid a total payment equal to the amount due under the Contract including retainage within thirty (30) days in accordance with ORS 279C.570

F. Monies earned by the Contractor are not due and payable until the procedures set forth in the Contract for inspection, approval, and acceptance of the work; for determination of the work done and the amount due therefore; for the preparation of the final estimate and Certificate of Final Completion and processing the same for payment; for consideration of the Contractor's claim, or claims, if any; and for the preparing of a revised final estimate and Certificate of Final Completion and processing same for payment all have been carried out.

G. As a prerequisite to final payment, if the Contractor is not domiciled in or registered to do business in the State of Oregon, the Contractor will provide the Project Manager with evidence that the requirement of ORS 279A.120(3) has been satisfied.

H. If the City declares a default of the Contract, and surety completes the Contract, all payments made after declaration of default and all retainage held by the City shall be paid to surety and not to the Contractor in accordance with the terms of the Contract.

I. Unless otherwise specifically noted and documented as required in **Subsection 109.05** or this subsection, acceptance by the Contractor of final payment shall release the City and the Engineer of Record from any and all claims by the Contractor whether known or unknown, arising out of and relating to the work. No payment, however, final or otherwise, shall operate to release the Contractor or its sureties from warranties or other obligations required in the performance of the Contract.

****END OF DIVISION****

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201 EROSION PREVENTION AND SEDIMENT CONTROL

201.01 DESCRIPTION

This section covers, but is not limited to, construction entrances, sediment fences/barriers, temporary interceptor swales, temporary sediment basins, mulching, ground cover, and inlet protection for erosion and sediment control provisions.

201.02 MATERIALS

Provide all materials required in conformance with the City of Gresham Erosion Prevention & Sediment Control Technical Manual, included herein.

201.03 CONSTRUCTION

201.03.01 General

Construction shall conform to the City of Gresham Erosion Prevention & Sediment Control Technical Manual, included herein.

201.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

201.04.01 Lump Sum Basis

When shown in the Proposal, payment for erosion prevention and sediment control provisions will be made on a lump sum basis for all erosion and sediment control provisions within the limits specified.

201.04.02 Incidental Basis

When not listed in the Proposal for separate payment, all erosion and sediment control provisions will be considered incidental work for which no separate payment will be made.

202 TRAFFIC CONTROL

202.01 DESCRIPTION

This section covers all work necessary to conduct construction operations so as to offer the least possible obstruction and inconvenience to the public and to protect pedestrian and vehicular traffic.

202.02 MATERIALS

202.02.01 Uniform Traffic Control Devices

Provide barricades, signs, and traffic control devices built in conformance with the Manual on Uniform Traffic Control Devices (MUTCD), current edition, published by the U.S. Department of Transportation, and the Oregon supplements to the Manual published by the Oregon Department of Transportation.

202.03 CONSTRUCTION

202.03.01 General

The Contractor shall assign at least one appropriately trained and certified person on each project to have day-to-day responsibility for assuring that the traffic control elements are operating effectively and that any needed operational changes are brought to the attention of their supervisors.

Use flag persons and provide and maintain such signs, barricades, warning lights, and other traffic control devices in conformance with the manuals referenced in **Subsection 202.02.01**. Adequately warn the public at all times of existing conditions on all streets affected by work operation.

Patrol the construction area at least twice daily and reset all disturbed signs and traffic control devices immediately. Remove or cover non-applicable signs when not needed. Prior to closing or partial closing of any street, conform to **Subsection 107.04**.

The Contractor shall be responsible for damages to property, injury to persons, loss, expense, inconvenience, and delay caused by or resulting from any act, omission, or neglect of the Contractor, the Contractor's subcontractors and suppliers, or their employees while performing the work.

Road users should be guided in a clear and positive manner while approaching and within construction, maintenance, and utility work areas.

Do not stop or hold vehicles, block driveways, intersections, or connections for more than 5-minutes unless otherwise authorized. Allow emergency vehicles immediate passage.

Provide and maintain, in a safe and functional condition, temporary access to business and residence driveways, temporary intersections, and temporary connections with roads, streets, bikeways, sidewalks, and footpaths.

While working on subgrade and other construction, provide adequate access to business, residences, intersections, and connections by maintaining existing gravel connections with well graded aggregate ramps and existing asphalt and concrete connections with temporary cold or hot mix asphalt ramps. Dispose of the temporary material in a manner satisfactory to the Manager.

Provide approved access to private properties at all times, except during stages of construction when it is impractical to perform construction and maintain access to private property simultaneously, as determined by the Engineer. When access is to be denied, notify occupants of affected properties at least 24-hours in advance.

Steel road plates are allowed for a maximum of 5-days per opening and must have a cold mix ramp transition on all edges exposed to traffic. Steel plates shall be removed after 5-days and will be replaced with either a temporary cold or hot asphalt mix. In either case a smooth transition over the construction project will be required at all times. Steel road plates shall be pinned down at all intersections, or roads where the speed limit is higher than 25 MPH. Contractor shall make permanent repairs to the asphalt surface immediately after underground work has been completed.

Keep the surface being used by bicycles free of all dirt, mud, gravel, and other harmful materials. These surfaces include bike paths, bike lanes, roadway shoulders, or the outside 6-feet of the roadway.

When, in the judgment of the Engineer, vehicular parking is a hazard to through traffic or to the work, furnish and place NO PARKING signs on any street that is directly involved in the construction work.

At the end of each working day, backfill pavement edge excavations to the elevation of the existing pavement with permanent base material or with temporary wedge of aggregate as shown on the plans.

Do not excavate along both edges of the pavement adjacent to traffic at the same time. Before excavating at the edge of the pavement on the opposite side of the roadway, complete the construction to existing pavement elevation on the side that was excavated first.

Remove the temporary wedge of aggregate material, if used, before placing permanent base material, and place it in the shoulder slope area or spread it uniformly over the subgrade.

202.03.02 Lane and Sidewalk Restriction Requirements

Obtain the Engineer's approval before closing any lanes or sidewalks and do not close any lane or sidewalk until the area is signed according to the plans and the requirements of this section.

In general the existing lanes of traffic should be open and in operation through the project at all times.

One lane may be closed to traffic in the immediate work area but only during hours work is actually performed and in accordance with an approved traffic control plan.

All lanes may be closed to traffic if such closure is determined to be in the public's interest. Submit proposed methods of street closure times in each instance to the Engineer for approval in ample time to allow the traveling public to be notified through the news media.

Do not perform work that would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time unless explicitly approved by the Engineer.

More than one intersection cannot be closed concurrently without prior explicit approval by the Engineer. The Contractor will notify the Police and Fire Departments in the jurisdiction of the closing and opening of streets. Pedestrian detours shall not exceed one block in length and all footbridges will be provided with adequate handrails.

When construction requires the closure of a sidewalk or sidewalk ramp, place a Type "W1" SIDEWALK CLOSED sign at each point of closure. Also use a Type "W1" directional arrow rider, as needed, to direct pedestrian traffic. Mount each sign above the striped panel on a Type II barricade that is placed across the sidewalk facing pedestrians approaching the work area. Close the sidewalk at a point where there is an alternate way to proceed.

Per the GRC requirements, do not close any traffic lane, sidewalk, or parking lane during the annual Holiday Construction Ban period, commencing at 6:00 p.m. on Friday preceding Thanksgiving and running until midnight January 2, without a written waiver from the Manager.

Do not close any traffic lanes Monday through Friday between 4:00 p.m. and 8:00 a.m. the following day unless otherwise explicitly approved by the Engineer on the traffic control plan.

In addition, do not close any traffic lanes between:

- 3:00 p.m. on Fridays and 12:00 midnight on Sundays
- 12:00 noon on the day preceding legal holidays or holiday weekends and 12:00 midnight on legal holidays or the last day of holiday weekends.

For the purposes of this section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday of September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

202.03.03 *Traffic Control Plans*

Formulate and submit a traffic control plan and a work schedule to minimize the disruption of traffic. Plan shall be submitted at the pre-construction conference. If no conference is held, plan shall be submitted at least 5 working days in advance of beginning work, 10 working days in advance of beginning work if a street closure is involved. Obtain approval of plan and schedule from Engineer and any other governing authority before commencing work. Allow traffic to pass through the work with as little inconvenience and delay as possible.

The traffic control plan shall contain a complete signing plan for semi-permanent and portable signs, barricades, and other traffic control provisions to keep the signs or devices current with the construction activities and the illumination of all detours and obstructions during hours of darkness. Be responsible for furnishing, installing, and maintaining all traffic control devices. Maintain these devices at all times including non-working hours.

The following information must be included in all traffic control plans prior to submitting for approval:

- 1) State date and time of day that construction will take place.
- 2) Specify what kind of work is being performed.
- 3) Provide name and number of person who can be contacted at all hours in case of emergency.

Approval by the Engineer of a general submittal for traffic control that does not identify specific request(s) for variance to the standards, such as outside lane restrictions of normal hours, will be deemed a denial of those specific items.

It will be the **Contractor's responsibility** to ensure that all traffic control plans follow the guidelines as outlined in the MUTCD.

Contractor is required to notify and provide a copy of the traffic control plan to all emergency service providers, school bus services, and Tri-Met (if lane closure is on a bus route) after the traffic control plan has been approved, and a minimum of 48-hours prior to scheduled construction.

202.03.04 *Construction and Maintenance of Detours*

Construct and maintain temporary detours for protection of the work and the safe passage of traffic around work area.

Conform to requirements for detours in ***Subsection 103.16***.

202.03.05 *Flagging Requirements*

The Contractor shall provide and maintain such signs, barricades, and warning lights as are necessary to warn and protect the public at all times on highways, roads, or streets affected by work operations. In addition, the Contractor shall also provide all necessary flag persons and guards necessary to warn and protect the public. Each flagger on duty shall wear a hard-hat and vest that conform to ODOT and/or OSHA requirements and shall be equipped with a highly visible, reflectorized "Stop/Slow" hand sign conforming to current standards for daylight use and with illuminated stand area of high visibility for night use.

For work zones on low volume rural roads that require flaggers, a single flagger may be adequate if the flagger is visible to approaching traffic from all appropriate directions.

Qualifications for Flaggers

- past three years.
- Completed and passed an ODOT-approved work zone, traffic control course within the
 - The mental and physical ability to provide timely, clear, and positive guidance.
 - A sense of responsibility for safety of public and work crew.
 - A neat appearance.
 - A courteous but firm manner.

202.04 MEASUREMENT AND PAYMENT

202.04.01 Lump Sum Basis

When listed in the Proposal as a separate pay item, payment for Temporary Traffic Control will be made on a lump sum basis.

202.04.02 Incidental Basis

When not listed in the Proposal for separate payment, all Temporary Traffic Control will be considered incidental work for which no separate payment will be made.

203 MOBILIZATION

203.01 DESCRIPTION

This section covers, but is not limited to, work necessary to obtain all bonds, insurance, licenses, and permits; move in personnel and equipment; set up all offices, buildings, and facilities; provide all required light, power, and water; install project information signs if required; prepare for construction completion; demobilize, including removal of all facilities and clean up; and all other work to successfully complete the project that is not covered in other bid items.

203.02 MATERIALS

Provide all materials required to accomplish the work as specified.

203.03 CONSTRUCTION

203.03.01 General

Set up construction facilities in a neat and orderly manner within designated or approved work areas. Provide for an acceptable material and equipment storage area. Supply all labor and equipment necessary to accomplish the work as specified. Conform to applicable requirements of **Section 107** including, but not limited to, required notifications, protection of surveying monuments and other markers, temporary traffic control, temporary utility connections, protection of property, water and air pollution, and noise.

203.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

203.04.01 Lump Sum Basis

When mobilization is listed as a separate pay item on the Proposal, it will be paid for on a lump sum basis. Normal retainage will be deducted from partial payments.

Partial payments for mobilization under the Contract will be made under the following schedule:

1. When 5% of the total original contract amount is earned from other bid items, 50% of the amount bid for mobilization, or 5% of the total original contract amount, whichever is the least, less normal retainage, will be paid.

2. When 10% of the total original contract amount is earned from other bid items, 100% of the amount bid for mobilization, or 10% of the total original contract amount, whichever is the least, less normal retainage, will be paid.

3. Upon completion of all work on the project, payment of any amount bid for mobilization in excess of 10% of the total original contract amount will be paid.

The above schedule of progress payments for mobilization shall not be construed to limit or preclude partial payments otherwise provided by the Contract.

203.04.02 *Incidental Basis*

When not listed in the Proposal, all mobilization costs will be considered incidental work for which no separate payment will be made.

204 CLEARING AND GRUBBING

204.01 *DESCRIPTION*

This section covers work necessary to clear, remove, and dispose of all debris and vegetation such as stumps, trees, logs, roots, shrubs, vines, grass, and weeds within the designated limits, to preserve from injury or defacement such objects and vegetation as are designated to remain in place, and to perform final clean-up of the designated area.

Clearing is defined as cutting of trees, bushes, vines, and other vegetative growth at or above ground surface and removal from the site of all such cut or downed vegetation.

Grubbing shall consist of the elimination of wooden and vegetative matter occurring at or below ground surface including, but not limited to, stumps, trunks, roots, canes, stems, debris remaining from clearing work, and sticks having a diameter of one inch or more.

Review with the Project Manager the location, limits, and methods to be used prior to commencing work under this section.

For publicly financed improvements, removal of man-made structures including, but not limited to, concrete slabs, walls, vaults, footings, asphaltic surfaced areas, and graveled areas, shall be included in payment for excavation or excavation and backfill as provided in **Subsection 204.03.04**, and will not be included in clearing and grubbing.

As indicated in **Subsection 107.08**, owners of buildings fronting to the work shall have salvage rights to plants, trees, shrubs, fences, and other improvements in the right-of-way. Contractor shall notify adjacent property owners. Contractor does not assume ownership of clearing and grubbing items until after fulfilling the requirements of **Subsections 107.08** and **204.03.02**.

204.02 *MATERIALS*

Materials shall conform to requirements of **Section 205**.

204.03 *CONSTRUCTION*

204.03.01 *General*

No explosives shall be used without the expressly written permission of the Engineer.

The Contractor shall obtain the required permits as specified in ***Subsection 107.08*** and perform clearing work in conformance thereto.

Remove trees and plants as designated within the area of work and remove all sod, topsoil, and organic earth within designated areas.

Remove and stockpile as directed all topsoil that is free of roots, rocks, and other objectionable material and is determined by the Engineer to be suitable for future use. Take reasonable care to prevent topsoil from becoming mixed with subsoil.

For publicly financed improvements, provide imported topsoil per ***Subsections 206.02.07*** and ***206.02.08***, at no expense to the City, when existing topsoil is not adequately segregated as determined by the Engineer.

204.03.02 *Timber Salvage*

204.03.02A *Trees in Street Right-of-way*

The adjacent property owner shall have the right to any trees felled in the right-of-way adjacent to owner's property. Contractor shall notify adjacent property owners by mail or door-hanger at least 48-hours prior to felling trees. Trees shall be stacked and decked on owner's property or removed from the construction site if the owner does not reserve the right of ownership.

204.03.02B *Trees on City-owned Property*

Owner reserves the right to merchant timber as designated in the Contract Documents and as marked at the project site by the Engineer. The Contractor shall cut, trim, and handle marked merchantable timber in such a manner as to ensure the best sale value to owner and dispose of resulting waste materials as hereinafter specified, and shall assume ownership, remove, and dispose of all other timber.

204.03.03 *Protection of Existing Vegetation*

Protect all trees, shrubbery, and other vegetation not designated for removal from damage caused by the work. Cut and remove trees and branches only where approved by the Engineer. When directed by the Engineer, remove branches other than those required to provide a balanced appearance of any tree. Contractor will provide adequate protection for trees, shrubbery, and other vegetation adjacent to the work area that are to remain, as indicated on the plans. No roots projecting into the excavation will be cut except in the presence of the Inspector. All roots authorized to be cut will be cut neatly with a sharp tool to avoid torn root endings. Remove branches only as directed by the Engineer and treat scars with approved tree sealant.

204.03.04 *Clearing*

The Contractor shall clear the area above the natural ground surface of all vegetation and objectionable materials in accordance with approved plans. Cut timber and timber growth so that no stump extends above ground surface more than 6-inches. Prune all limbs over paved streets to an elevation 14-feet above the pavement on arterial and collector streets, and 11-feet above the pavement on residential streets. Prune all limbs over sidewalks to an elevation 7.5-feet above the sidewalk. All such pruning shall be done in accordance with accepted arboricultural standards, and shall be approved by the Project Manager.

204.03.05 *Clearing Borrow and Waste Disposal Areas*

The Contractor shall clear areas designated as borrow and waste disposal areas to designated limits and dispose of all waste as herein specified.

204.03.06 *Grubbing and Stripping*

The Contractor shall completely remove all stumps and roots within the limits of required excavations and fill areas. No stumps or portion thereof shall come within 3-feet of fill subgrades or slope surfaces. Use of explosives for stump removal shall conform to requirements of ***Subsections 204.03.01*** and ***205.02.02***. Obtain any and all permits required for use of explosives from controlling jurisdiction.

On areas to be occupied by fills, remove all grass, roots, and embedded wood to a depth not less than 3-feet below subgrade or slope surface on which the fill is to be constructed.

On excavation areas, remove all roots and embedded wood to a depth not less than 1-foot below subgrade or slope surface through which excavation is required.

204.03.07 *Disposal of Waste Material*

The Contractor shall remove and dispose of all waste material or debris from the site and shall obtain all necessary permits for disposing of waste materials. Copies of such permits shall be provided to the Project Manager prior to disposal.

204.03.08 *Backfilling and Clean-up*

The Contractor shall fill all holes and depressions caused by clearing and grubbing with material acceptable to the Engineer and reshape area to drain properly and to conform to adjacent undisturbed topography.

The Contractor shall leave the work area in a clean and sightly condition, free from litter and debris.

204.03.09 *Removal and Replacement of Signs, Mailboxes, Posts, etc.*

The Contractor will be responsible for the removal and replacement of all signs, mailboxes, posts, etc., when not specifically designated otherwise by the Engineer. Contractor will contact property owner prior to removal and reinstallation of mailbox. Mailboxes in work area must be temporarily moved to allow clearing and excavation as well as easy access by mail carrier and residents. Upon completion of excavation, mailboxes shall be permanently replaced behind curb to postal service regulations.

204.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

204.04.01 *Lump Sum Basis*

When shown in the Proposal, payment for clearing and grubbing will be made on a lump sum basis for all clearing and grubbing within the limits specified.

204.04.02 *Incidental Basis*

When not listed in the Proposal for separate payment, all clearing and grubbing will be considered incidental work for which no separate payment will be made.

205 MATERIALS - TYPES AND USE

205.01 DESCRIPTION

This section covers certain types of materials and their use that are common to appropriate forms of construction contained throughout Divisions Three through Six.

205.02 MATERIALS

205.02.01 General

Unless specified otherwise in the Contract Documents or Standard Drawings, materials contained herein will be used in required work.

205.02.02 Explosives

Explosives must be fresh, stable materials manufactured to the standards of the “Institute of Makers of Explosives” and conform to applicable requirements of ORS Chapters 476 and 480.

205.02.03 Water

Water used in all work must be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, or other deleterious substances. Use water conforming to AASHTO T-26 for mixing and curing Portland Cement Concrete, mortar, or grout. Water of approved potable quality may be used without test.

205.02.04 Aggregates

205.02.04A General

Aggregates shall be subject to approval at the source or at the actual stockpile from which the aggregate is taken for incorporation in the work. During production of the aggregate, provide samples of each size for testing if requested by the Engineer. On the basis of testing, modify or adjust crushing and screening operations to bring each separate size of aggregate within gradings, proportions, and quantities as specified.

In all stages of production, transporting, and stockpiling, handle aggregates in such a manner as will prevent the segregation of materials and the intermingling of separate gradings or kinds of aggregates.

Grading of designated aggregate sizes shall conform to the requirements of appropriate types of work contained within applicable sections throughout these specifications.

The determination of sizes and grading of aggregate shall conform to AASHTO T-27 and AASHTO T-11.

Durability

The source material from which aggregate is produced shall meet the following qualifying test requirements:

Test	Test Method	Requirements
Degradation:		
Passing No. 20 Sieve	ODOT TM-208	30% Maximum
Sediment Height	ODOT TM-208	3" Maximum
Abrasion	AASHTO T-96	30% Maximum

Other sampling and testing of aggregate shall be in accordance with the following methods:

Sampling	AASHTO T-2
Material Passing No. 200 Sieve	AASHTO T-11
Organic Impurities	AASHTO T-21
Sieve Analysis	AASHTO T-27
Soundness	AASHTO T-104
Friable Particles	AASHTO T-112
Lightweight Pieces	AASHTO T-113
Sand Equivalent	AASHTO T-176
Wood Particles	ODOT TM-225
Elongated Pieces	ODOT TM-229

205.02.04B Coarse Aggregates

Coarse aggregates shall be natural or crushed rock or gravel that is retained on a No. 4 sieve and is free from flat, elongated, soft, or disintegrated pieces, vegetable material, or other deleterious matter.

Use crushed rock for coarse aggregate in aggregate bases and all asphalt construction requiring coarse aggregate. Coarse aggregate in Portland Cement Concrete may also use natural gravel or other inert materials of similar characteristics or combinations thereof. Total deleterious matter shall not exceed 2% by weight.

Do not allow amount of deleterious substances to exceed the following amounts:

Lightweight Pieces	0.25% (by weight)
Friable Particles	0.25% (by weight)
Material Passing No. 200 Sieve	1.00% (by weight)
Wood Particles	0.05% (by weight)

Use coarse aggregates having weighted percentages of loss that do not exceed 12% by weight when subjected to five alternations of the sodium sulfate soundness test (AASHTO T 104).

For Portland Cement Concrete: Coarse aggregate must conform to the specified maximum size, and when each maximum size is separated into designated sizes, the separated designated sizes shall be as follows:

Maximum Size of Aggregates	Separated Sizes
2"	(2" – 1"), (1" – No. 4)
1½"	(1½" – ¾"), (¾" – No. 4)
1"	(1" – No. 4)
¾"	(¾" – No. 4)

Do not allow oversized and undersized materials to exceed a combined 15% of any separated size, nor allow any pieces to have any dimension greater than twice the maximum square screen size for the specified grading.

Grading of each of the specified separated sizes of coarse aggregate shall conform to the following:

GRADING REQUIREMENTS COARSE AGGREGATE – PORTLAND CEMENT CONCRETE				
Separated Sizes – Percentages (by weight)				
Sieve Size Passing	2" – 1"	1½" – ¾"	1" – No. 4	¾" – No. 4
2½"	100			
2	90 – 100	100		
1½"	35 – 70	90 – 100	100	
1"	0 – 15	30 – 65	90 – 100	100
¾"		0 – 15	50 – 80	90 – 100
⅜"			15 – 40	20 – 50
No. 4			1 – 10	0 – 10

For extrusions use the gradation specified in **Subsection 607.02.02**.

When a tolerance range is set forth in the above grading requirements, it shall be understood that the midpoint of the tolerance range is the target value and the product shall conform as closely as realistically possible to this target value. The purpose of the tolerance range is only to permit occasional minor variations from the target value that are, for practical reasons, unavoidable.

When coarse aggregate is to be separated into two sizes as set forth hereinabove, control grading of material in each separated size within the applicable range of percentages given in grading requirements for coarse aggregate hereinabove so that the quantity of each separated size measured into the batch shall be not less than 35% nor more than 65% of total quantity of coarse aggregate measured into the batch.

Fracture of Gravel

When crushed gravel is furnished, it shall have at least two mechanically fractured faces on not less than the following percentages (by weight) of the material as determined by ODOT WAQTC TMI.

Type of Use	Percentages
Asphalt Concrete Pavement	75
Asphalt Surface Treatment	95
Asphalt Treated Bases	75
Aggregate Bases	70
Aggregate Trench Backfill	70

205.02.04C Fine Aggregate

Use fine aggregate consisting of finely crushed rock or gravel, fine sand, and other finely divided natural and inert mineral matter, thoroughly washed, and free of clay, loam, shale, alkali, vegetable matter, and other deleterious matter. Do not mix fine aggregate from different geological sources, and do not store in the same pile nor use alternately in the same class of construction or mix.

Fine aggregate shall meet the fracture face specification in **Section 205.02.12B** and shall not have deleterious material content exceeding the following limits:

Friable Particles	1% (by weight)
Lightweight Particles	1% (by weight)
Material Passing No. 200 Sieve	1% (by weight)

When this fine aggregate for Portland Cement Concrete is subject to five alternations of the sodium sulfate soundness test (AASHTO T-104), weighted percentage of loss must not exceed 10% by weight.

Asphaltic concrete and surface treatments shall contain fine aggregate having a weighted loss of not more than 15 mass percent when sodium sulfate is used or 20 mass percent when magnesium sulfate is used in five cycles of the soundness test. Total deleterious matter shall not exceed 2% by weight.

Use fine aggregates that meet the durability requirements for coarse aggregates contained hereinbefore, and that meet the following liquid limit and plasticity index requirements:

Quality	Test Method	Requirement
Liquid Limit	AASHTO T-89	NP or 33 Maximum*
Plasticity Index	AASHTO T-90	NP or 6 Maximum*

*When tested as specified, both the liquid limit and the plasticity index test results shall conform to the following:

Percent of Material Passing No. 40 Sieve	AASHTO T-89 Liquid Limit (Maximum)	AASHTO T-90 Plasticity Index (Maximum)
0.0 to 5.5, Inclusive	33	6
5.1 to 10.0, Inclusive	30	5
10.1 to 15.0, Inclusive	27	4
15.1 to 20.0, Inclusive	24	3
20.1 to 25.0, Inclusive	21	2
Over 25.0	21	0 or NP

For Portland Cement Concrete: Fine aggregate must be graded from coarse to fine within the following limits. All fine aggregate shall meet the requirements of ASTM C-33.

GRADING REQUIREMENTS FINE AGGREGATE – PORTLAND CEMENT CONCRETE	
Sieve Size Passing	Percentages (by weight)
$\frac{3}{8}$ "	100
No. 4	90 – 100
No. 16	45 – 75
No. 30	25 – 55
No. 50	5 – 30
No. 100	0 – 8

For extrusions, use the gradation specified in **Subsection 607.02.02**.

Use fine aggregate that has a sand equivalent of not less than 68, and that develops in the mortar strength test taken at seven days, a compressive strength of at least 95% of mortar using Ottawa sand.

Sand for mortar shall conform to the requirements of AASHTO M-45; testing shall conform to ASTM C-109 for mortar strength.

205.02.05 *Portland Cement*

Furnish one or more of the following types as specified:

Type I	–	For general use when special properties of other type cements are not required
Type IA	–	Air-entraining cement for same uses as Type I, where air-entrainment is desired
Type II	–	For use when moderate sulfate resistance or moderate heat of hydration is desired
Type IIA	–	Air-entraining cement for same uses as Type II, where air-entrainment is desired
Type III	–	For use when high early strength is desired
Type IIIA	–	Air-entraining cement for same use as Type III, where air-entrainment is desired

Portland Cement shall conform to AASHTO M-85 for low alkali cement except as follows:

1. Total alkali content (sodium and potassium oxide calculated as $\text{Na}_2\text{O}+0.658\text{K}_2\text{O}$) shall not exceed 0.6%.
2. Types I, IA, III, or IIIA must contain a maximum of 10% tricalcium aluminate.
3. Time-of-setting tests shall be by either the Gilmore test or the Vicat test or both, as Engineer elects.

When not otherwise specified, use Type I. Contractor, at his option, may use Type III Portland Cement (high early strength) in lieu of Type I in the identical quantity specified for the latter.

Differing brands or types of cement, or the same brand or type of cement from different plants, shall not be mixed during use nor be used alternately. Cement may be sampled either at the plant or site of work at the option of the Engineer.

205.02.06 *Cement Mortar*

Use either standard premixed mortar conforming to ASTM C-387, or mortar proportioned with 1-part Portland Cement to 2-parts clean, well-graded sand which passes a $\frac{1}{8}$ -inch screen and which conforms to AASHTO M-45. Admixtures may be used, but do not exceed the following percentages of cement by weight: hydrated lime – 10%; diatomaceous earth or other inert materials – 5%. Testing shall conform to ASTM C-109 for mortar strength.

205.02.07 *Cement Grout*

205.02.07A *Type "A" Grout*

Utilize grout that consists of 1-part Portland Cement, 3-parts clean and well-graded sand by volume. Use minimum amount of water to produce a thick, creamy consistency.

205.02.07B Type "B" Grout

Where Type "B" grout is specified, use a mixture consisting of 1-part Portland Cement, 5-parts clean and well-graded sand, and 7-parts pea gravel, by volume. Use minimum amount of water to produce a thick, creamy consistency.

205.02.07C Non-shrink Grout

Non-shrink grout shall be Sika 212, Euco N-S, Five-Star, or equal non-metallic, cementitious commercial grout exhibiting zero shrinkage per ASTM C-827. Grout shall not be amended with cement or sand, and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20-minutes and shall not be used.

Non-shrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout being used. Water as a substitute for commercial bonding agent for non-shrink grout will not be allowed.

205.02.08 Epoxy Cement

Epoxy cement shall be a two-compound epoxy resin adhesive conforming to requirements of AASHTO M-235.

205.02.09 Portland Cement Concrete

Use concrete having a 28-day design strength of 3,300psi for curbs, sidewalks, and poured-in-place manholes and catch basins, and 5,000psi minimum for Portland Cement Concrete pavement and commercial driveways per AASHTO T-22 and T-23 with 1½-inch maximum size aggregate.

High-early strength concrete (Type III cement) shall be used when patching trenches in Portland Cement Concrete pavement.

Use Type II cement concrete for all sewer and water main construction and appurtenances thereto.

Portland Cement Concrete shall be sampled and tested in accordance with the following ASTM test methods:

1.	Sampling fresh concrete	C-172
2.	Obtaining drilled cores	C-42
3.	Molding and curing specimens	C-31
4.	Compressive strength	C-39
5.	Flexural strength	C-78
6.	Slump	C-143
7.	Air content	C-173 or C-231
8.	Unit weight yield	C-138
9.	Setting of mortar	C-191 or C-266

205.02.09A Admixtures

Air-Entraining Admixtures – Air-entraining admixtures shall conform to AASHTO M-154 (ASTM C-260) using one or another of several tests as directed by the Engineer. Chloride content of admixture must not exceed 0.5% by weight.

Water-reducing, Retarding, and Accelerating Admixtures – Water-reducing, retarding, and accelerating admixtures shall conform to AASHTO M-194 (ASTM C-494) using one or more of several tests as Engineer may direct. Chloride content of admixture must not exceed 0.5% by weight.

205.02.09B Steel Reinforcement

Use steel deformed bars conforming to ASTM A-615, Grade 40; except, longitudinal bars in continuously reinforced concrete pavement shall be Grade 60.

Ties and supports shall be of 16-gauge, black, soft-annealed wire and bar supports for the intended uses. Bar supports in beams and slabs exposed to view after stripping must be galvanized or plastic coated. Use concrete supports for reinforcing in concrete placed on grade. Galvanizing shall conform to ASTM A-152 Class D. Plastic shall not chemically react with concrete, shall be impervious and have a minimum thickness of 3/32-inches at point of contact with form.

205.02.09C Dowels

Utilize steel dowels that conform to ASTM A-306 Grade 70. Where specified, dowels shall be coated with plastic or other approved material for bond prevention.

205.02.09D Joint Material

Preformed Expansion Joint Fillers – Use preformed expansion joint fillers for concrete conforming to AASHTO M-153 or AASHTO M-213 except that those furnished under AASHTO M-213 shall be tested in conformance to ASTM D-1751. Fillers conforming to AASHTO M-213, except the binder if other than bituminous material, may also be used provided that they otherwise meet these specifications and provide further that they have been demonstrated to be rot and vermin proof for a period of at least 5-years. Preformed elastomeric joint seals must conform to AASHTO M-220. Poured filler must conform to AASHTO M-173.

Flatwork Joints – For joints in Portland Cement Concrete pavement refer to **Section 208**. For curbs, gutters, driveways, sidewalks, and pathways, refer to **Subsection 607.03.07**.

Compound for Precast Manhole Section Joints – Preformed plastic gaskets conforming to the requirements of AASHTO M-198 or joints using confined O-ring with rubber gaskets conforming to ASTM C-443 shall be used.

Water Stop – Water stop shall be either plastic or rubber as the Contractor may elect conforming to the following:

(a) Plastic – Polyvinylchloride water stop shall be manufactured to the dimensions called for on the plans from virgin polyvinylchloride (PVC) compound. No reclaimed PVC will be allowed. The water stop shall have the following properties:

ASTM Test Method	Specification
Tensile, PSI	D 412 1800
Elongation%	D 412 350
100% Modulus, PSI	C 412 760
Low Brittle Temperature	D 746 50° F
Cold Bend Test*	No Failures
*Samples maintained at minus 70° F for 2 hours then bent quickly around a 1/4" mandrel to 180°	

The supplier shall furnish test samples of the material from which his water stop is to be manufactured. Samples shall be in sheet-form having a uniform thickness of from 1/16 to 1/8 inch and having a total area of not less than 2 sq. ft. Each sample shall be comprised of pieces not smaller than 6 in. x 6 in.

(b) Rubber – Rubber water stop shall be manufactured to the dimensions shown on the plans in such a manner that the finished product shall have an integral cross section which will be dense, homogeneous, and free from porosity and other imperfections. The water stop shall have the following properties:

Hardness	–	The shore A Durometer hardness shall be 60 to 70 when tested in accordance with ASTM D-2240
Elongation	–	Minimum of 450%
Tensile Strength	–	Minimum of 3000 pounds per square inch
Water Absorption	–	Maximum of 55% by weight after immersion in water for 2 days at 158° F

Tensile Strength After Aging – The test specimen, after accelerated aging of 7-days at 158° F, shall retain not less than 80% of the original tensile strength. The tensile strength of the test specimen, after accelerated aging of 48-hours in oxygen at 158° F and tensile stress of 300 pounds per square inch, shall be not less than 80% of the original tensile strength.

Compression Set – After 22-hours at 158° F, shall be not more than 30% when tested in accordance with ASTM D-395, Method B.

Specific Gravity – 1.17 ± 0.03 .

Defects – Minor surface defects such as surface peel covering less than one square inch, surface cavities or bumps less than 1/4-inch in longest lateral dimensions and less than 1/16- inch deep will be acceptable.

205.02.09E *Curing Materials for Portland Cement Concrete*

Conform to one or more of the following requirements for curing materials; choice of method to be used is dependent on weather and existing conditions:

1.	White burlap – polyethylene sheets	AASHTO M-171
2.	Waterproof paper	AASHTO M-171
3.	White, pigmented liquid, membrane-forming compound**	AASHTO M-148
4.	White polyethylene film	AASHTO M-171
5.	Burlap cloth (Jute or Kenaf)	AASHTO M-182
**Required for Portland Cement Concrete curbs, but do not use on bridges or box culverts. Test in accordance with the OSHD modified procedure.		

205.02.10 *Asphalt Materials*

205.02.10A *General*

Unless otherwise specified herein or in applicable subsections, types and grades of material shall conform to the current ODOT/APWA Oregon Standard Specifications for Construction.

The asphalt cement furnished under this specification shall be petroleum asphalt prepared by the refining of crude petroleum and, when necessary, by the addition of modifiers designed to provide the asphalt characteristics specified. It shall be homogeneous and free from water and it shall not have been distilled at a temperature high enough to injure by burning or high enough to produce flecks of carbonaceous matter. It shall meet the requirements of AASHTO MO-98, Standard Specification for Performance Graded Asphalt Binder, at the time of use when tested according to the methods specified.

205.02.10B *Asphaltic Cement*

Use performance grade (PG) 64-22 asphalt that meets ODOT requirements.

205.02.10C Tack Coat

Asphalt shall consist of CSS-1 or CSS-1h emulsified asphalts.

205.02.10D Slurry Seal

The emulsified asphalt shall conform to grade and be of the "Quick Set" type such as CQS1H SSI, 551H, CSS-1, CSS-1H quick set mixing grade as specified in ASTM D-977, D-2397, AASHTO M-140 and M-208 requirements of ISSA TB102, "Mixing, Setting, and Water Resistance Test to Identify Quick Set Emulsified Asphalts."

205.02.11 Geotextiles

205.02.11A Description

Geotextiles will be accepted for use in various applications according to the provisions of this section.

205.02.11B Definitions

(a) **GEOTEXTILE** – A fabric manufactured specifically for use in civil engineering applications. Fibers used in the manufacture of geotextiles consist of long chain synthetic polymers; at least 85% by weight of the long chain polymers are polyolephins, polyesters, or polyamides.

- 1) DRAINAGE GEOTEXTILE – For installation in subsurface drains or other drainage locations.
- 2) EMBANKMENT GEOTEXTILE – For installation within or under embankments for stabilization.
- 3) RIPRAP GEOTEXTILE – For installation behind and beneath riprap, buttresses, inlays, shear keys, and erosion control applications.
- 4) WALL GEOTEXTILE – For construction of retained earth walls.
- 5) SUBGRADE GEOTEXTILE – For installation on subgrades and in other material separation applications.
- 6) PAVEMENT OVERLAY GEOTEXTILE – For installation beneath an asphalt concrete overlay.

(b) **MACHINE DIRECTION** – The long, or warp, direction of the geotextile. The cross-machine, or fill, direction is perpendicular to the machine direction.

(c) **NON-WOVEN GEOTEXTILE** – A textile produced by bonding and/or interlocking of fibers by mechanical, heat, or chemical means.

(d) **ROLL** – Unit of continuous geotextile without transverse seams as furnished by the manufacturer. Roll size may vary between manufacturers and types of geotextiles.

205.02.11C Acceptance Requirements:

Base the actual minimum average roll values furnished by the manufacturer on representative test results from the manufacturing plant that produced the rolls. The geotextile shall meet or exceed each of those specified minimum values. Clearly label all rolls that are part of the same production run certified as meeting all applicable requirements.

The geotextile shall:

- Be composed of a polymeric yarn or fiber oriented into a stable network that retains its relative structure during handling, placement, and design service life.
- Meet or exceed the properties outlined under Geotextile Property Values.

- Be free of any chemical treatment or coating that might significantly reduce permeability.
- Have the selvage finished so the outer fibers are prevented from pulling away from the fabric.
- Be free of defects or tears.
- Be resistant to ambient temperatures, acid and alkaline conditions, micro-organisms and insects.
- Be for the intended purpose and have dimensional stability.

GEOTEXTILE PROPERTY VALUES Minimum Value						
Geotextile Property <i>Test</i> <i>Method</i>	Drainage (1) Geotextile Type 1/ Type 2	Riprap (1) Geotextile Type 1/ Type 2	Subgrade Geotextile	Embankment Geotextile	Wall (1) Geotextile	Pavement (1) Overlay Geotextile
Grab tensile strength minimum in each principal direction – <i>ASTM D-4623</i>	80 lb/ 180 lb	200 lb/ 260 lb	180 lb	230 lb	---	80 lb
Grab elongation – <i>ASTM D-4632</i>	15%	15%	---	---	---	50%
Burst strength, diaphragm method – <i>ASTM D-3786 Mod. (OSHA TM-814) (TF-25 Method 3)</i>	130psi/ 290psi	320psi/ 430psi	290psi	430psi	---	---
Puncture strength – <i>ASTM D-4833 or ASTM D-3787 Mod. (ODOT TM-816)</i>	35 lb/ 80 lb	80 lb/ 110 lb	80 lb	110 lb	---	---
Apparent opening size (AOS), U.S. std. sieve – <i>ASTM D-4751 (CW-02215 Corps of Engr.)</i>	No. 70 sieve or smaller opening	No. 70 sieve or smaller opening	No. 30 sieve or smaller opening	No. 30 sieve or smaller opening	(2)	---
Water permeability – <i>ASTM D-4491</i>	0.1 cm/sec	0.1 cm/sec	0.005 cm/sec	0.005 cm/sec	(2)	---
Ultraviolet stability – <i>ASTM D-4355 at 500 hours</i>	---	70% strength retained	---	---	70% strength retained	---
Wide strip tensile strength – <i>ASTM D-4595</i>	---	---	---	---	(2)	---
Asphalt retention – <i>ODOT TM-817</i>	---	---	---	---	---	0.20 gal/sq yd
Melting point – <i>ASTM D-276</i>	---	---	---	---	---	300° F

205.03 CONSTRUCTION

205.03.01 Geotextiles

This work consists of furnishing and placing geotextiles in drains, under embankments, for embankment reinforcement, under riprap, buttresses, inlays, shear keys and erosion control applications, behind retaining structures, over roadbed subgrades, and beneath pavement overlays as shown on the plans and at other locations as directed by the Engineer.

Installation Requirements

Acquisition and Storage – Provide complete rolls of geotextile as furnished by the manufacturer and protect against damage and deterioration. Store all geotextile rolls in a dry place and off the ground at all times according to ASTM D-4873. Cover all rolls and partial rolls with a dark protective covering when received. The geotextile will be rejected for use if the Engineer determines it has defects, deterioration, or has been damaged.

Placement:

(1) Surface Preparation – Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle in any way.

Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.

(2) On Slopes – Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the top of the lower sheets. When the geotextile is placed on a slope steeper than 6:1, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

(3) Where Exposed To Water – When geotextiles are placed under water or in areas where water will flow, the geotextile may be placed with the machine direction parallel to the direction of water flow instead of the placement direction specified on slopes, if approved by the Engineer. Overlap sheets so the upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place geotextile more than 50-feet ahead of the specified cover material.

Overlaps – Minimum overlap requirements for geotextiles are:

GEOTEXTILE APPLICATION	MINIMUM OVERLAP REQUIREMENT, INCHES
Drains	12
Embankment stabilization	24
Geotextile wall reinforcement	24
Pavement overlays	**
Riprap and rock buttresses	24
Roadbed subgrade stabilization	24
**Use sufficient overlap to ensure closure, but not more than 6-inches.	

If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or sew the geotextile together in the field.

Field Seams:

(1) **General** – Obtain the Engineer's approval before field seaming and stitching. Sew field seams with polymeric thread consisting of polypropylene, polyester, or kevlar, and as resistant to deterioration as the geotextile being sewn. Use a color of thread that contrasts with the geotextile being sewn so the stitches are exposed for inspection when the geotextile is placed. Seams must achieve 90% of the product's tensile and grab strengths.

(2) **Equipment** – Use field seam stitching equipment that provides an acceptable lock-type stitch as recommended by the geotextile manufacturer and approved by the Engineer.

(3) **Seam Type** – Obtain the geotextile manufacturer's recommendation for the type of seam and stitch to be used. If the Contractor does not obtain and provide the foregoing technical information, use a "J" seam with at least 3 stitches per inch. The flat, or prayer, seam may be used for repair of damaged in-place geotextile.

Protection of Geotextile – Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff, and construction activities.

Traffic or construction equipment will not be permitted directly on the geotextile except as authorized.

When placed for construction, cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than 5-days.

Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted. Use a minimum 6-inches thick cover layer or twice the maximum aggregate size, whichever is thicker. End-dumping cover material directly on the geotextile will not be permitted.

Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than 3-inches deep or half the layer thickness, whichever is lesser. Turning of vehicles on the first layer will not be permitted.

Repair of Geotextile – Repair or replace all torn, punctured, or contaminated geotextiles during construction at no cost to the City. Repair by placing a patch of the specified geotextile over the affected area. Overlap the existing geotextile with the patch. Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions or as directed.

205.03.01A *Drainage Geotextile*

When used in trenches for drains, place the geotextile in the trench as shown on the plans to loosely conform to the shape of the trench with no wrinkles or folds.

205.03.01B *Embankment Geotextile*

Construct embankment stabilization according to details shown on the plans. Place the geotextile layers so the geotextile machine direction is transverse to the embankment centerline. Spread the geotextile so all slack and wrinkles are eliminated.

205.03.01C *Riprap Geotextile*

Place geotextile behind and beneath riprap, buttresses, inlays, shear keys, and erosion control applications according to the details shown. Demonstrate to the satisfaction of the Engineer that the combination of the rock-fill drop height and the thickness of any aggregate cushion, when specified or required, are adequate to not puncture or damage the geotextile when placing the riprap or stone embankment material. In addition, the following limits apply:

Maximum Drop Height, Feet		
Size of Rock Material	Onto Geotextile	Onto an Aggregate Cushion Blanket
Greater than 200 lbs.	0	3
200 lbs. or less	3	3

After placing the riprap, backfill all voids in the riprap face so the geotextile is completely covered and not visible.

205.03.01D Wall Geotextile

(a) **General** – Begin wall construction at the lowest portion of the excavation and place each layer horizontally as shown on the plans. Complete each layer in its entirety before the next layer is started. Seams will be allowed only at the wall face. Either overlap geotextile sheets perpendicular to the wall or sew seams parallel to the wall face. Stretch the geotextile in a perpendicular direction to the wall face to eliminate slack before backfilling.

(b) **Forming the Wall** – Use a temporary form system at the wall face during construction. Use pegs, pins, or the manufacturer's recommended method as approved by the Engineer, in combination with the forming system, to hold the geotextile in place until the cover material is placed.

(c) **Backfill for Wall Construction** – Compact the backfill for the wall within the limits shown on the plans or as directed by the Engineer of Record. Compact each layer to 95% of maximum density as determined AASHTO T-180. Maintain the water content to within $\pm 3\%$ of the optimum moisture content. Sheepsfoot rollers and vibratory rollers or other rollers with protrusions will not be allowed within 3-feet of the wall face. Compact this area using approved light mechanical tampers, without damaging or distorting the wall facing or reinforcing layers.

205.03.01E Subgrade Geotextile

Subgrade geotextile shall be installed in accordance with **Subsection 508.03.02**.

205.03.01F Pavement Overlay Geotextile

Pavement overlay geotextile shall be installed in accordance with **Subsection 508.03.03**.

205.04 MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)

205.04.01 Geotextiles

Square Unit Basis (Measurements) – Each geotextile installation will be measured along the lines and grades of the installation to the nearest square yard of surface area actually covered according to the plans or as required, except for drainage and wall geotextile applications.

The number of square yards of drainage geotextile will be computed by multiplying the length of the trench where geotextile is used by the perimeter of the trench as determined from the neat lines shown.

Geotextile walls will be measured to the nearest square foot of wall face computed by multiplying the length times the sloped height of the wall.

Square Unit Basis (Payment) – The accepted quantities for geotextiles will be paid for at the contract price per unit of measurement for the following items:

UNIT OF PAY ITEM MEASUREMENT		
(a)	Drainage geotextile	Square Yard
(b)	Embankment geotextile	Square Yard
(c)	Riprap geotextile	Square Yard
(d)	Wall geotextile	Square Yard
(e)	Subgrade geotextile	Square Yard
(f)	Pavement overlay geotextile	Square Yard
Item (d) includes all backfilling costs and geotextile as shown on the plans.		
Item (f) includes preparation work, sealant, and geotextile.		

Payment will be payment in full for all equipment, tools, labor, and incidentals necessary to complete the work. No separate payment will be made for constructing laps, seams, joints, and patches unless the Engineer orders additional amounts over the minimum. For laps wider than the minimum or specified width, payment will be made for the added lap width at the contract unit prices.

If the Engineer orders geotextiles with properties more stringent than specified, price adjustment will be allowed only for the difference in material cost.

206 EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL

206.01 DESCRIPTION

206.01.01 General

This section covers work necessary for excavation, construction of embankment, foundation stabilization, pipe bedding, pipe zone backfill, trench backfill, and disposal of material required in construction of streets, wastewater systems, water systems, storm drain systems, structures, and appurtenances thereto.

206.01.02 Unclassified Excavation

Unclassified excavation is defined as all excavation, regardless of type, nature, or condition of materials, encountered unless separately designated. The Contractor shall assume full responsibility to estimate the kind and extent of various materials to be encountered in order to accomplish the work.

206.01.03 Rock Excavation

Rock excavation is defined as the removal of all material that, by actual demonstration, cannot, in Engineer's judgment, be reasonably excavated with equipment comparable to types listed in TABLE 1 and equipped with rippers or similar approved equipment and which is, in fact, systematically drilled and blasted or broken by power-operated tools designed for rock excavation. The Engineer may waive the demonstration if material encountered is well-defined rock. The term "rock excavation" shall be understood to indicate a method of removal and not a geological formation.

TABLE 1			
Manufacturer	Model	Minimum Net Horsepower	Type of Excavation
Caterpillar	225	125	Trench
John Deere	690	125	Trench
Case	125B/980B	125	Trench
Caterpillar	D8	300	Grading & Structural

In trenches, boulders, or pieces of concrete below grade larger than half cubic yard will be classified as rock if drilling and blasting or other approved methods are actually used for their removal from the trench. If material that would be classified as rock by the above definition is mechanically removed without blasting, breaking, or splitting, it will be considered unclassified excavation, or upon approval by the Engineer of Record if larger equipment is specifically brought in for the sole purpose of rock removal, as defined above, then such removal will be considered rock excavation.

206.01.04 *Trench Excavation*

Trench excavation is defined as removal of all material encountered in the trench to the depths and widths as shown and, unless otherwise classified by the Contract Documents, shall be considered unclassified or rock excavation.

206.01.05 *Embankment*

Embankment is defined as furnishing, placing, and compacting embankment materials to the depth and configuration as shown in the Contract Documents or as directed by the Engineer.

206.01.06 *Foundation Stabilization*

Foundation stabilization is defined as the removal of unsuitable material in the bottom of an excavation as approved by the Engineer and replacement with specified material for support of a roadbed, pipe, structure, or appurtenances thereto.

206.01.07 *Pipe Zone*

Pipe zone is defined as the full width of the trench from 6-inches below outside of the pipe barrel to a point 12-inches above the top outside surface of the pipe barrel.

206.01.08 *Trench Backfill*

Trench backfill is defined as furnishing, placing, and compacting backfill material in the trench between the top of the pipe zone and the bottom of the pavement base or ground surface. Trench backfill will be classified as either native or select backfill.

206.02 *MATERIALS*

206.02.01 *Embankment Materials*

The Contractor shall provide native or imported embankment materials approved by the Engineer of earth, sand, crushed aggregate, bank-run or river-run gravel or combinations thereof, that can be compacted to the densities specified, free of peat, humus, muck, frozen ground, organic matter, or other materials detrimental to construction of firm, dense, and sound embankments. Maximum size of material shall be 6-inches in diameter unless otherwise approved by the Engineer.

206.02.02 *Foundation Stabilization*

Use foundation stabilization consisting of gravel or crushed aggregate ranging in size from 6"– 0" to ¾"– 0" as specified and approved. Material shall be well graded from coarse to fine unless otherwise specified by the Engineer of Record, shall be free from organic material, and shall not have more than 5% by weight passing the #200 sieve.

206.02.03 *Pipe Zone Material*

Use pipe zone material consisting of ¾"– 0" crushed aggregate, or sand as required by the Contract Documents.

Pipe zone material shall be as specified in **Section 206.02.05A** for crushed aggregate and as specified in this section for sand.

Sand shall consist of fine granular material naturally produced by the disintegration of rock produced from crushed gravel or from river dredging. Sand must be reasonably free of organic material, mica, clay, and other deleterious substances.

The grading of sand shall conform to one of the following grading requirements as specified. Gradation and sizes shall be determined per AASHTO T-27 and T-11.

Sieve Size	Percentage Passing by Weight	
	Coarse Sand	Fine Sand
1"	100	100
$\frac{3}{8}$ "	95 – 100	---
#4	80 – 100	90 – 100
#30	10 – 30	---
#100	---	2 – 10
#200	0 – 8	0 – 4
Sand Equivalent	50 Minimum	50 Minimum

Table ranges are inclusive of tolerances. Material must be able to stand on a minimum 60° angle from horizontal following compaction to specified density. For the purpose of this specification, specified density will be a minimum of 95% of relative density as determined by AASHTO T-180 at optimum moisture.

206.02.04 Native Backfill Material

Native backfill material use is limited to trench backfill where the trench is not beneath a roadway or a designated future roadway, and its use must be approved by the Engineer.

The Contractor shall use native material excavated from within limits of the project that can be compacted to the density specified, that is free from vegetation and other deleterious material, and that contains no frozen ground.

Maximum particle size shall not exceed 6-inches in diameter.

206.02.05 Select Backfill Material

The Contractor shall use imported granular material for backfill consisting of crushed aggregate or controlled density fill as specified.

206.02.05A Crushed Aggregate

Coarse and fine aggregates shall conform to requirements of **Section 205** and to additional requirements contained herein.

Crushed aggregates to be incorporated in the work shall have a sand equivalent of not less than 50 when tested in conformance with AASHTO T-176.

Crushed aggregate shall meet the requirements for Liquid Limit and Plasticity Index of **Subsection 205.02.04C**.

The crushed aggregates shall be uniformly graded from coarse to fine and shall conform to one of the following grading requirements as specified. Gradation and sizes shall be determined per AASHTO T-27 and T-11.

Separated Sizes						
Percentages Passing (by weight)						
Sieve Size	2½" – 0	2" – 0	1½" – 0	1" – 0	¾" – 0	¼" – 0
3"	100					
2½"	95 – 100	100				
2"		95 – 100	100			
1½"			95 – 100	100		
1¼"	55 – 75					
1"		55 – 75		90 – 100	100	
¾"			55 – 75		90 – 100	
½"				55 – 75		100
⅜"					55 – 75	
*¼"	*30 – 45	*30 – 45	*35 – 50	*40 – 55	*40 – 60	85 – 100
#10						0 – 15
#40						0 – 5
Table ranges are inclusive of tolerances. *Of the fraction passing the ¼" sieve, 40% to 60% shall pass the #10 sieve.						

206.02.05B Controlled Density Fill

Controlled Density Fill (CDF) shall be accepted in lieu of granular fill as a backfill material in any excavation. CDF shall be a mixture of Portland Cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, free-flowing, and excavatable material that will result in a hardened, dense, non-settling fill. CDF shall be required in all Multnomah County and ODOT rights-of-way where specified in each permit.

CDF backfill will be required in the following cases: 1) Where mechanical equipment cannot adequately compact the backfill material; 2) as the top 4-feet of backfill where manholes are installed in existing paved streets; and 3) where it is deemed necessary by the Engineer.

Strength Requirements

Hand excavated, non-structural CDF shall produce unconfined compressive 28-day strength of 100psi (tolerance +50psi, –20psi). CDF that is to be hand excavated shall contain aggregate no larger than ⅜-inch aggregate and comprising no more than 40% of the total aggregate content.

Materials

Portland Cement shall meet the standards as set forth in ASTM C-150, Type I or II Cement.

Fly ash shall meet the standards as set forth in ASTM C-618, for Class F pozzolans. The fly ash shall not inhibit the entrainment of air.

Air Entraining agent shall meet the standards as set forth in ASTM C-260.

Aggregates need not meet the standards as set forth in ASTM C-33. Any aggregates that will produce the desired performance characteristics of the CDF considered, will be accepted for consideration, except as follows. The amount of material passing a #200 sieve shall not exceed 12%, and no plastic fines shall be present.

Proportioning

CDF shall be a mixture of cement, Class F pozzolan, sand, sometimes coarse aggregate, air entraining agent, and water. It is usually batched by a ready mixed concrete plant and delivered to the job site by means of transit mixing trucks.

The actual mix proportions shall be determined by the producer of the CDF to meet job site conditions, minimum or maximum strengths, and unit weight. Entrained air content shall be a minimum of 8.0%. The actual entrained air content shall be established for each particular job with the materials and aggregates to be used to meet the placing and unit weight requirements. Entrained air content may be as high as 20% for fluidity requirements.

The table below provides a guideline for CDF mixes. The weights shown are only an estimate of the amount to be used per cubic yard of CDF. Actual amounts may vary from those shown as approved by the Engineer or approved trial mix data or field test results for proper strength, workability, consistency and density.

CLASS OF CONTROLLED DENSITY FILL	CLASS 100 HAND EXCAVATABLE
Maximum compressive strength, PSI allowable variation, PSI	100 (+50/-20)
Maximum gallons of mixing water per cubic yard	30 to 50
Lbs. of cement per cubic yard, approximate	30 to 50
Lbs. of fly ash per cubic yard, approximate	200
Lbs. of dry aggregate per cubic yard, approximate (assumed SP.G. 2.67)	3200

1. If air entraining or water reducing admixture is used for flowability, total water and aggregates may be adjusted for yield.
2. For publicly financed improvements, design with prior test results shall be submitted to the Engineer for acceptance prior to placement.
3. Weights may be adjusted for flowability and pumpability.

206.02.06 *Riprap*

Riprap consists of 2-inch or 4 – 2-inch open graded crushed rock conforming to **Subsection 205.02.04**, having at least two fractured faces on 90% of the material, and being free from organic material.

206.02.07 *Imported Topsoil*

Unless specified otherwise, imported topsoil shall be used. Provide natural, fertile, friable topsoil, representative of local productive soil, and 90% free of clay lumps or other foreign matter larger than 2-inch diameter, not frozen or muddy, with pH 5.0 to 7.0, and not less than 3% humus as determined by loss on ignition of moisture-free samples dried at 100° C. Gravel portion (particles larger than 2 mm) shall not exceed 15% of total volume. Imported topsoil shall be free of quack grass, horsetail, and other noxious vegetation and their seeds. Should such regenerative material be present in the soil all resultant growth, both surface and root, shall be removed and replaced to original specifications at the Contractor's expense within 2-years of acceptance of the work.

206.02.08 *Native Topsoil*

When specified, use topsoil from the site. Save, store, protect, and reuse approved native topsoil taken from the top 12-inches of the excavation. Ensure that topsoil is free from grass, overburden and roots, sticks, hard clay, and any stones that will pass a 1-inch square opening. Wherever native topsoil cannot be saved or is

not satisfactory for reuse, use imported topsoil conforming to **Subsection 206.02.07**, but only with the approval of the Engineer.

206.02.09 *Water*

Use water that conforms to requirements of **Section 205**. Provide water at the Contractor's sole expense. Whenever City water is to be used, the Contractor shall obtain a meter issued by the City.

206.03 *CONSTRUCTION*

206.03.01 *Excavation*

Excavate, remove, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions, encountered within limits hereinafter defined or as specified, necessary for construction of the project. Method of excavation used is optional. Overbreak shall be removed at the Contractor's expense. Use hand methods for excavation that cannot be accomplished without endangering existing or new structures or other facilities. Excavations shall also comply with requirements of **Subsection 204.03.06**.

Furnishing, installing, and removal of all shoring, sheeting, and bracing as required to support adjacent earth banks and structures, and for the safety of the public and of all personnel working in the excavation shall be the Contractor's responsibility and shall be considered incidental to the construction.

206.03.02 *Rock Excavation and Explosives*

206.03.02A *Depth of Excavation*

Excavate to the depths designated or as shown on the appropriate plan or standard drawing. Correct over-excavation with compacted material as directed at no additional expense to City. In trenches for sewers and water mains or conduits, remove all material necessary to provide a minimum clearance of 6-inches under the pipe and replace with bedding material in conformance with **Subsection 206.02.03**.

206.03.02B *Methods and Records Required*

Before rock removal by systematic drilling and blasting, or other methods, will be permitted, notify Engineer who, with Contractor or its representative, will determine the amount of material to be removed as rock excavation and will record the information. Then drill, blast, or break with power-operated tools specially designed for rock excavation, and excavate the material.

206.03.02C *Use of Explosives*

Obtain any and all permits required for use of explosives required by the City of Gresham, and other governing agencies. No explosives shall be used without the expressed written permission of the Engineer.

Use of explosives shall be avoided as far as practicable, and in no case shall tunnel-blasting methods be used. Such blasting as must be done shall be controlled in a manner that will avoid possible shattering or loosening of materials back of lines to which the excavations are to be made. All blasting shall be supervised and/or done by a state-certified powder person. Be responsible for any and all damages to property or injury to persons resulting from blasting, or accidental or premature explosions that may occur in connection with the use of explosives. Give adequate warning to all affected persons and adjacent property owners prior to blasting.

Where excavations in hard, solid rock is to be made to depths of 10-feet or more; blasting thereof shall be done by the presplitting or preshearing method unless other methods are approved by Engineer.

206.03.02D *Trench Blasting*

When blasting rock in trenches, cover area to be shot with blasting mats or other approved types of protective material that will prevent scattering of rock fragments outside of the excavation.

206.03.03 *Preservation of Existing Improvements*

Conduct operations in such a manner that existing streets, utilities, railroad tracks, structures, and other facilities which are to remain in place will not be damaged, as specified in **Section 107**. Furnish and install cribbing and shoring, or whatever means necessary to support material carrying existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.

Protect temporary facilities, until they are no longer required, and remove and dispose of temporary supports and other protective means when they are no longer required.

206.03.04 *Excavation of Existing Improvements and Miscellaneous*

Unless otherwise specifically provided for, excavation or excavation and backfill includes all excavating, removing, hauling, and depositing, including but not limited to, existing pavements, walks, driveways, surfaces, slabs, curbs, gutters, and similar cement concrete structures, bituminous materials, all rock or gravel road surfacing materials, abandoned sewers, pipes and conduits, logs, piling, footings, foundations, vaults, and chambers, when such materials are within the limits of excavation.

Remove remaining ends of abandoned pipes, or portions of other items partially removed under this work, that would be left exposed after final excavation, to a minimum of 1-foot below the finished grade or elevation. Plug or seal ends of abandoned pipes in backfill or embankment areas. Storm drainpipe shall be reconnected as directed by the Engineer.

Payment for all work in this section and repair of any damage will be considered incidental to the work and included under bid items for Excavation, Excavation and Backfill, or other specified earthwork items.

206.03.05 *Limits of Excavation*

Excavate to the depths and widths designated, allowing for forms, shoring, working space, base material, and finish topsoil where required. Do not excavate deeper than elevation shown. Excavation carried below grade lines shown or established without approval shall be replaced with approved compacted material at the Contractor's expense. Over-excavation under footings shall be filled with concrete of a strength equal to that of the footing, and cuts below grade shall be corrected by similarly cutting adjoining areas and creating a smooth transition, all at the Contractor's expense. When the precise location of subsurface structures is unknown, locate such structures by hand excavation prior to utilizing mechanical excavation equipment.

206.03.06 *Slope Grading*

Make slopes free of all exposed roots, unstable rock, and loose stones exceeding 3-inches in any dimension. Shape tops of banks to circular curves with, in general, not less than a 6-foot radius, unless rock makes such work impractical. All surfaces shall be neatly and smoothly trimmed.

206.03.07 *Foundation Stabilization*

If, in the judgment of the Engineer of Record, having consulted with the Contractor, material in the bottom of an excavation is unsuitable for supporting foundations, piers, retaining walls, cribbing, sewers, pipes, or similar facilities, the Contractor shall over-excavate as necessary for successful construction of the facility and backfill to required grade with thoroughly compacted foundation stabilization material conforming to **Subsection 206.02.02**.

206.03.08 *Disposal of Excess Material*

Excavated materials not suitable or not required for backfill or embankment shall be deposited at predesignated sites specified, or sites supplied by the Contractor. An embankment permit will be necessary within the City for any embankment exceeding 50 cubic yards before the Contractor places any excavated material from City projects on any property. The Contractor shall make all arrangements for disposal of excess material, obtain the necessary permits when not provided by the City at predesignated sites, and bear all cost or retain any profit incidental to such disposal.

206.03.09 *Temporary Location of Excavated Materials*

Place excavated material specified for embankment or backfills only, not excess material, within the construction easement, right-of-way, or specified working area. Pile in such a manner that it will cause a minimum of inconvenience to the public. Furnish the Engineer a copy of written approval from each property owner prior to stockpiling material on private property outside of easements. Conform to all federal, state, and local codes governing the safe loading of ground adjacent to trenches with excavated material.

Provide free access to all fire hydrants, water valves, and meters, and leave clearance to enable free flow of stormwater in all gutters, conduits, and natural watercourses.

206.03.10 *Surface Removal and Replacement for Trenches*

206.03.10A *Removal and Replacement of Topsoil*

When specified and where trenches within easements cross lawns, garden areas, pasture lands, cultivated fields, or other areas on which topsoil conditions exist, remove all topsoil to a depth of at least 12-inches for the full width of the trench to be excavated. Stockpile topsoil to one side of the easement in an approved location and do not mix with remaining excavated material. Replace and compact removed topsoil in the top of backfilled trench to the depth removed.

Maintain finished grade of topsoil level with area adjacent to the trench until final acceptance by the Engineer. Repair damage to adjacent topsoil caused by work operations. Remove all rock, gravel, clay, and any other foreign materials from surface; re-grade and add topsoil as required.

In lieu of stockpiling topsoil, Imported Topsoil as defined in **Subsection 206.02.07** may be substituted and replaced to the actual depth removed at the Contractor's expense. If, in the opinion of the Engineer, the Contractor does not take precautions to protect the stockpiled topsoil from contamination by rocks, clay, excess water, etc., the Contractor will be required to import topsoil meeting the requirements of **Section 206.02.07** at Contractor's own expense.

For publicly financed improvements, payment for removing, stockpiling, and replacing topsoil in the trench is included in the Trench Excavation and Backfill bid item.

206.03.10B *Removal of Pavement, Curbs, Driveways, and Sidewalks*

Cut all asphalt pavement to full depth with a pavement saw or other suitable pavement cutter prior to excavation of trenches.

Saw Portland Cement Concrete pavement, curbs, and sidewalks to a minimum depth of 4-inches or half the concrete thickness, whichever is greater. Subsequent removal may be accomplished by using a jackhammer; but, if the Contractor damages the portion of the facility that is to remain, it shall be replaced to the nearest joint at no expense to the City. Full depth cut by pavement saw can be done at the option of the Contractor. Use of any machine utilizing a falling or swinging weight in the form of a "headache ball" will not be permitted.

No slurry, dust, or other material created by sawcutting will be allowed to enter the storm drain system.

Width of cut shall be as shown on the plans or standard drawings. Remove all loose, undermined, or damaged pavement. Remove all pavement between the trench and curb, pavement edge, or construction joint whenever the cut is 3-feet or less from the curb, pavement edge, or construction joint. Joints shall not be located in wheel paths. Prior to paving, all loose, cracked, sunken, or otherwise damaged edges will be sawcut in continuous straight cuts. Straight-line sawcut lengths will not be less than 50-feet. Cut angles will not exceed 15°.

Pavement and concrete materials removed shall be hauled from the site and not used for trench backfill. Replacement of pavement, curb, and sidewalk shall conform to the requirements of **Section 210**.

206.03.11 Trench Excavation and Shoring

206.03.11A Maximum Length of Open Trench

Length of trench excavated in advance of the pipe laying shall be kept to a minimum, and in no case shall it exceed 200-feet unless otherwise authorized. The length of unrestored work area and total unfinished trench construction shall not exceed a length of 600-feet for main line pipe laying operation unless otherwise authorized. Trench construction will not be considered completed until all restoration is completed. If the unfinished trench or restoration exceeds 600-feet in length, the main line construction shall be suspended and shall not be resumed until authorized by the Engineer.

In no case will any trench be left unfinished or uncovered overnight or outside working hours.

For purposes of this subsection, trench shall be considered as unfinished until excavation, construction, backfilling, and resurfacing with temporary cold mix or the same material as the adjacent finished surface has been installed to finish grade, and cleanup operations have been completed. Cleanup of backfilled and construction area shall include resurfacing and cleaning of area so as to allow use of trench and adjacent construction area for normal use as required in **Section 211**.

Adjacent to Excavations – Where paved shoulders adjacent to excavations are less than 4-feet wide, protect the traffic as follows:

- At the end of each working day, backfill pavement edge excavations to the elevation of the existing pavement with permanent base material or with temporary wedge of aggregate as shown on the plans.

206.03.11B Trench Width

The maximum trench width at the ground surface will be kept to a minimum necessary to install the pipe in a safe manner. Trenches shall be of sufficient width to allow for shoring and permit proper joining of pipe and compaction of the backfill material along the sides of the pipe. Minimum trench width of unshored trenches shall provide a clear working space of at least 6-inches on each side of the outside diameter of the pipe bell. Shoring requirements shall be independent of trench widths.

Trench width at the top of the pipe will be the pipe nominal diameter plus 18-inches, except where specifically shown on the drawings, or specified in the Special Provisions. The pipe will be centered in the trench online and grade at all times. When authorized by the Engineer, the Contractor may use pipe of greater strength or install a superior pipe bedding in lieu of maintaining the trench widths shown. If maximum width shown is exceeded by Contractor (without written authorization), the Contractor shall provide pipe of a higher strength designation, a higher class of bedding, or both, as approved by the Engineer, at no expense to the City.

Make the excavation for manholes and other structures wide enough to provide a minimum of 12-inches between sides of structure and sides of excavation.

Confine top width of trench to dedicated rights-of-way or construction easements. Special written agreements to extend width may be made by the Contractor with affected property owners, provided such agreements are approved by the Project Manager.

206.03.11C *Grade*

Excavate trench to lines and grades shown or as established by the Engineer, with proper allowance for pipe thickness, pipe bedding, and foundation stabilization. The subgrade upon which bedding is to be placed shall be firm, undisturbed, and true to grade. If the trench is over-excavated without approval of the Engineer of Record, restore to grade with thoroughly compacted foundation stabilization material or pipe bedding material at the Contractor's expense. Place material over full width of the trench in compacted layers to established grade with allowance for pipe bedding.

206.03.11D *Shoring and Bracing of Trenches*

Shore and brace trench when necessary to prevent caving and to protect adjacent structures, property, workers, and the public. Increase trench widths by the thickness of the shoring and maintain shoring until pipe has been placed and backfilled at the pipe zone. Remove shoring as backfilling is done, in a manner that will maintain compaction of the backfill material in the trench and will not damage the pipe or permit voids in the backfill. All sheeting, shoring, and bracing of trenches shall conform to the safety requirements of the federal, state, or local agency having jurisdiction. The most stringent of these requirements shall apply.

206.03.12 *Dewatering*

Furnish, install, and operate all necessary machinery, appliances, and equipment to keep excavations free from water during construction. Remove and dispose of all water entering the trench excavation continuously during the time the trench is being prepared for the pipe laying, during the pipe laying, when concrete is being placed, and until the backfill has been completed. Dewater and dispose of water so as to prevent injury to public or private property, and to prevent nuisance or menace to the public. Drainage of trench water through the pipeline under construction is prohibited unless otherwise approved by the Engineer. At all times the Contractor shall have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage. The Contractor shall have available at all times competent workers for operation of the pumping equipment. Control surface runoff to prevent entry or collection of water in excavations.

Control ground water such that softening of the bottom of excavations or formation of "quick" conditions or "boils" during excavation shall be prevented. Design and operate dewatering systems so as to prevent removal of natural soils and so that ground water level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

Before dewatering is started, submit to the Project Manager a statement of the method, installation, and details of the dewatering system proposed to be used. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3-feet below static water table.

Release ground water to its static level in such a manner as to maintain the undisturbed state of natural foundation soils. Prevent disturbance of compacted backfill and flotation or movement of structures, water mains, sewers, and other utilities.

1. All foundation, vault, and trench de-watering water that has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond.
2. Clean, non-turbid de-watering water, such as well-point groundwater, can be discharged to the public system. These clean waters should not be routed through sediment traps or sediment ponds with stormwater.
3. Highly turbid or otherwise contaminated de-watering water, such as from construction equipment operation, clamshell digging, concrete pour, or work inside a cofferdam, shall be handled separately from stormwater at the site.

4. Other disposal options, depending on site constraints, may include: 1) sanitary sewer discharge with City Wastewater Services approval, 2) over-land infiltration, 3) filter fabric/media filtration, or 4) transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute local or state waters.

For publicly financed improvements, dewatering shall be considered as incidental to, and all costs included in, the various contract pay items in the Proposal.

206.03.13 *Compaction*

Compaction shall be by mechanical methods only.

Compaction equipment shall be of suitable type and adequate to obtain the amount of compaction specified. Compaction equipment shall be operated in strict accordance with the manufacturer's instructions and recommendations and shall be maintained in such condition that it will deliver the manufacturer's rated compactive effort. Compaction equipment for granular materials shall be vibratory plate or vibratory drum compactors.

Any settlement noted in backfill, embankment, or in structures built over the backfill or embankment within the 2-year warranty period, in accordance with the GENERAL REQUIREMENTS, will be considered to be caused by improper compaction methods and shall be corrected at the Contractor's expense. Structures damaged by settlement shall be restored to their original condition by the Contractor at the Contractor's expense.

206.03.14 *Embankment*

206.03.14A *Embankment*

Preparation of Embankment Foundations:

Prior to construction of embankments, excavate and dispose of unstable material or unsuitable foundation material. Limit excavation to lines, grades, and cross sections shown. Fill basements, trenches, and holes that occur within embankment limits with specified material. Compact natural ground underlying embankments to the depth of grubbing or a minimum of 12-inches to density specified for the embankment material to be placed. Embankment construction shall also comply with requirements of *Subsection 204.03.06*.

Embankment Construction:

Construct embankments to the lines and grades shown. Deposit material in layers thin enough to ensure compaction requirements are achieved throughout the entire lift and not exceeding 12-inches deep across the full width of the embankment. Place material in continuous horizontal layers. Compact each lift to the appropriate density as determined by AASHTO T-180.

Embankment for structural foundations the maximum aggregate size shall not exceed 3-inches and shall be compacted to not less than a relative maximum density of 95% throughout the embankment. For all other embankments, the compacted materials within 3-feet of established subgrade elevation shall have a density in place of not less than 95% of relative maximum density, and below 3-feet shall have a density in place of not less than 90% of relative maximum density, and will show no appreciable deflection or adverse reaction under the compacting equipment during compaction.

If the surface of the prepared foundation or the compacted surface of a preceding lift is too dry or smooth to bond properly with the next layer of material, moisten or scarify, or both, before the next layer of material is placed. Compact slopes of all embankments thoroughly, and true to line and grade.

Do not place embankment material when the material, foundation, or previously placed embankment material is frozen. Embankment material shall not be placed in final position until moisture in excess of optimum moisture has been removed. Water settling of embankments will not be permitted.

206.03.14B Pipeline Embankment

Where pipelines are to be placed within an embankment, construct the embankment to its final specified elevation prior to trench excavation for the pipeline. Place pipe bedding and pipe zone materials in accordance with applicable portions of *Subsections 206.03.15* and *206.03.16*. Place trench backfill material as specified in *Subsection 204.03.17*.

206.03.15 Pipe or Conduit Pipe Zone Bedding

Construct bedding in conformance with the appropriate standard drawing.

Class A Pipe Zone Bedding consists of a pipe cradle of Portland Cement Concrete as shown on the appropriate standard drawing. Bottom of trench shall be fully compacted before placement of pipe or cradle. Place concrete in such a manner that no dirt or foreign material become mixed with the concrete. Allow concrete sufficient time to reach initial set before any additional backfill material is placed in the trench. Conform to applicable provisions for concrete encasement in DIVISIONS 3 (WASTEWATER) and 4 (STORMWATER).

Class B Pipe Zone Bedding consists of leveling the bottom of the trench or top of the foundation material and placing pipe bedding select material to the horizontal centerline (springline) of the pipe. Bedding select material shall be placed in at least two lifts. Place the first lift to provide the minimum depth of bedding select material shown on the appropriate standard drawing before the pipe is installed. Spread smoothly to proper grade so that pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Bedding under pipe shall provide a firm, unyielding support along the entire pipe length. Place subsequent lifts of not more than 6-inch-thickness up to the horizontal centerline of the pipe. Bring lifts up together on both sides of the pipe and carefully work under pipe haunches.

Pipe zone bedding shall be considered to include full width of excavated trench from the bottom of the trench or top of the foundation stabilization material to the top of the bedding.

Particular attention must be given to the area from the invert to the horizontal centerline of the pipe or top of the bedding to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone.

206.03.15A Bedding for Flexible Sewer Pipe

Material for bedding sewer pipe shall be as specified. Place in more than one lift. Material for pipe bedding PVC pipe shall be $\frac{3}{4}$ "–0" or crushed rock placed a minimum of 6-inches under the pipe. First lift shall provide the minimum thickness per Standard Drawing No. 311 under any portion of the pipe and be placed before the pipe is installed. Spread smoothly so that the pipe is uniformly supported along the barrel. Install subsequent lifts of not more than 6-inch-thickness to the top of pipe zone and individually compact to either 90% of maximum dry density as determined by AASHTO T-180.

206.03.15B Bedding for Water Pipe

Place bedding to a minimum thickness of 5-inches below the outside bottom of the pipe barrel or conduit and compact with mechanical vibrating or impact tampers to 95% of maximum density as determined by AASHTO T-180. For coal tar coated steel pipe, sand-bedding material is required. Material for pipe bedding for water pipe shall be $\frac{3}{4}$ "–0" select backfill except for waterline wrapped with polyethylene encasement or coal-tar coated steel pipe, in which case sand shall be used within the entire pipe zone area.

206.03.16 Pipe Zone Placement

Place pipe zone material carefully around the pipe in 6-inch-layers and compact to a minimum of 95% maximum dry density as determined by AASHTO T-180 for water pipes and to a minimum of 90% of maximum dry density as determined by AASHTO T-180 for all other pipes. Prevent pipe from movement either horizontally or vertically during placement and compaction of pipe zone material.

206.03.17 *Trench Backfill and Compaction*

206.03.17A *General*

The type of backfill to be used above the pipe zone is indicated on the drawings. The right is reserved to modify the use, location, and quantities of the type of backfill during construction as the Engineer considers being in the best interest of the City.

When backfill is placed mechanically, push the backfill material onto the slope of the backfill previously placed and allow to slide down into the trench. Do not push backfill into the trench in such a way as to permit free fall of the material until at least 2-feet of cover is provided over the top of the pipe. Under no circumstances allow sharp, heavy pieces of material to drop directly onto the pipe or the tamped material around the pipe.

Take reasonable precautions to prevent excavated material that is designated to be used for backfill from becoming wet and exceeding the critical moisture limits. If native material does become wet and exceeds the critical moisture limits due to the Contractor's operations, replace with imported granular material at the Contractor's expense.

206.03.17B *Crushed Aggregate*

Backfill the trench above the pipe zone with imported crushed rock backfill material. Compact the entire trench depth in suitable lifts not to exceed 4-feet in depth, loose measure, with mechanical vibrating compactors with sufficient compactive effort to meet the specified density. Determine the type of equipment, method of placing lifts, and the amount of compacting effort required to prevent subsequent settlement. Compaction with hydra-hammer equipment will not be approved.

The top 3-feet of select backfill shall be compacted to 95% of maximum dry density as determined by AASHTO T-180.

In the zone below the top 3-feet of backfill, except water line trenches, compact to 90% of maximum dry density as determined by AASHTO T-180.

Any subsequent settlement of the finished surface during the 2-year warranty period shall be considered to be a result of improper or insufficient compaction and shall be promptly repaired by the Contractor at the Contractor's expense.

206.03.17C *Native Backfill*

Backfill the trench above the pipe zone with excavated trench material.

As shown on the construction drawings, leave the trench with the backfill material level with the existing ground for the entire width of the trench. Material will be compacted to a minimum of 90% maximum dry density as determined by AASHTO T-180. Any deficiency of backfill material that becomes apparent after settlement and within the warranty period shall be corrected by re-grading and adding additional material where required. Remove rocks larger than 2-inches in any dimension from the upper 8-inches of the backfill.

206.03.17D *Controlled Density Fill*

CDF shall be discharged from the mixer by any reasonable means into the area to be filled. The CDF shall be brought uniformly to the elevation as shown in the Contract Documents. Trench sections to be filled with CDF shall be contained at either end by bulkheads of earth fill.

CDF can be used **only** after the pipe, conduit, lateral, or fitting has been backfilled with crushed rock, pipe zone material as specified in **Subsection 206.02.03**, unless otherwise specified by

the Engineer. Where CDF is placed directly around waterline, polyethylene encasement is required around all waterline and fittings.

CDF shall not be placed on frozen ground. Subgrade on which CDF is placed shall be free of disturbed or softened material and water.

CDF batching, mixing, and placing may be started if weather conditions are favorable, as when the air temperature is at least 34° F or more and rising. At the time of placement, CDF must have a temperature of at least 40° F. Mixing and placing shall stop when the air temperature is 38° F or less and falling. Each filling stage shall be as continuous an operation as practical.

Permanent pavement may be placed directly upon the CDF as soon as it has sufficiently self-consolidated so that the surface will withstand the process of paving without displacement or disruption. If the placement of the CDF is not completed early enough to allow for permanent paving to be completed the same day, the Contractor shall provide steel plates to span the trench and prevent traffic contact with the CDF overnight or until permanent paving can be placed.

The Contractor shall provide test cylinders for laboratory testing by the City. Test cylinders shall be prepared in conformance with ASTM D-4832. Unless otherwise directed by the Engineer, a set of test cylinders shall be prepared for each day CDF is placed on the project. A set shall consist of two cylinders for testing at 7 days and two cylinders for testing at 28 days. The Engineer may permit other testing methods more suitable for low strength concrete.

206.03.17E *Compaction Testing*

Sampling and testing of materials for determination of compliance with the specified compaction requirements may be taken at any location and time as the Engineer may determine. Excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction. At the option of the Engineer, density tests may be taken on a lift of compacted backfill immediately before placing the next lift. All costs in connection with excavating test pits, providing and installing safety shoring as required to protect the testing person, and standby time during field density test shall be considered incidental to backfill and shall be included in unit price bid for the various items involved.

When compaction testing has been performed by the Engineer and the required density has not been obtained by the Contractor, the Contractor shall bear all costs for all subsequent retesting in the areas of non-compliance. All testing shall be performed by the testing laboratory of the Engineer. The Engineer shall keep an accurate account of the time spent for the testing laboratory to perform retesting. The Contractor shall be totally responsible for rescheduling compaction testing with the Engineer. Any and all costs for tests associated with delays due to retesting shall be the sole responsibility of the Contractor.

If required density has not been obtained, remove the backfill from the trench, replace with backfill, and re-compact as many times as it is necessary to obtain the required specified minimum densities.

206.03.17F *Trench Maintenance*

In graveled areas, maintain surface of the backfilled trench level with the adjacent and existing grade, before and after the area is opened to traffic, with 1"– 0" crushed aggregate material. In paved areas, temporary hot or cold mix asphalt pavement shall be used until the final pavement replacement is completed. The temporary asphalt or steel plating shall be in place at the end of each workday. Place temporary hot or cold mix asphalt in conformance with **Section 210**.

Maintain backfilled trench surface between any two successive manholes until the following operations have been completed and accepted by the Engineer:

1. Service connections installed, backfilled, and compacted.
2. Construction of manholes and appurtenances.

3. Air testing.
4. Cleanup and restoration of all physical features, including concrete curbs, gutters, and driveways.
5. Utilities restored to their original condition or better.
6. All work required between the two manholes accomplished.

Maintain backfilled trench surface between any two successive valves until the following operations have been completed and accepted by the Engineer:

1. Service connections installed, backfilled, and compacted.
2. Valves, valve boxes, and hydrants installed.
3. Hydrostatic testing.
4. Flushing and disinfection.
5. Cleanup and restoration of all physical features, including concrete curbs, gutters, and driveways.
6. Utilities restored to their original condition or better.
7. All work required between the two valves accomplished.

Do not undertake final pavement replacement until all items outlined above have been completed and accepted, unless otherwise approved by the Engineer.

Maintenance of backfilled trenches is considered as incidental to this item of work and payment for such maintenance will be considered as included in payment for Excavation and Backfill.

206.03.18 *Utility Permits*

206.03.18A *Permit Standards and Conditions*

Permits are issued, subject to the approval of City, state, or other governmental agencies having either sole or joint supervision over the section of road, to jurisdictions for approval of a storm or sanitary sewer system, or authority to regulate land use by means of zoning and/or building regulations. It shall be the applicant's responsibility to determine the necessity of and obtain any such easements and approvals that may be required.

Granting of a permit is conditioned upon replacement or restoration and any adjacent impacted areas by the applicant of the road right-of-way by the applicant to an equal or better condition than existed prior to permit issuance.

206.03.18B *Permit Implementation*

Applicant or his contractor shall advise the City at least 48-hours in advance of commencing construction of the facility authorized by the permit. The City may require adjustment of the construction schedule to permit inspection by the City.

The road approach or other facility shall be constructed in conformance with the Special Provisions and exhibits contained in and attached to the permit. Applicant shall notify the City when construction of the facility has been completed. If the work has not been constructed in a satisfactory manner, the applicant shall promptly correct any deficiencies outlined by the City.

206.03.18C *Allocation of Costs*

The entire cost of installing, maintaining, repairing, operating or using the road approach, sidewalk, pole line, buried cable, pipe line, sign, or miscellaneous facility; of performing miscellaneous operations; and of any other expense whatsoever incidental to the facilities or operations authorized by the permit shall be paid by the applicant.

The applicant shall reimburse the City for any reasonable and necessary expense that the City may incur in connection with the facilities or operations authorized by the permit. The reimbursement to the City shall be made by the applicant within 30-days after receiving a statement thereof from the City. These may include, but are not limited to, the following:

- Emergency repair by persons other than the permittee when authorized by the City.
- Emergency traffic control by persons other than the permittee when authorized by the City.
- Quality testing as required under the terms of the permit, or when ordered by the City to establish permit compliance.
- Repair of non-conforming installation (non-emergency) 30-days after notification by the City of non-conforming installation.

In the above instances, the owner of the utility, facility, or structure shall bear the full cost of the work. This cost would include all City costs and shall be paid to the City within 30-days after receipt of written notice of cost incurred by the City and request for payment. If payment is not made and the City must go to court to receive payment, the owner of the utility, facility, or structure shall bear all cost incurred by the City to receive payment associated with the court case.

206.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

206.04.01 Unclassified Excavation

All unclassified excavation will be measured on a cubic yard basis, or on a linear foot basis for trench excavation and backfill when so shown in the Proposal, all in original position prior to excavation. The quantity measured for payment will include only material excavated from within the limits defined herein. Any additional excavation outside of these limits, unless ordered in writing by the Engineer, shall be considered as having been made for Contractor's benefit and will be considered as incidental to the work. Excavation required for the volume displaced by new concrete curbs, driveway, sidewalks, steps, and pathways shall be considered incidental to the work and no payment will be made for removal of this material.

206.04.01A Roadbed and Slope Excavation

Pay quantities shall be computed to the neat lines of cross sections as staked or as otherwise specified.

206.04.01B Trench Excavation and Backfill

General

Length of all trenches will be measured horizontally along center of pipe or conduit from center-to-center of valves, fittings, couplings, manholes, structures, or end of pipe or conduit, whichever is applicable. Measurement through structures will be deducted if the Proposal carries a separate item of structure excavation applicable to the structures.

Measurement and payment for trench excavation and backfill shall include all work specified herein, or not specifically paid for in other pay items.

If a portion of the native material is approved as backfill material in areas requiring such, there may be a need for additional granular backfill to be imported. No additional payment will be made for the granular backfill. It will be considered incidental to the bid item for native backfill material.

Trench backfill above the pipe zone will either be native crushed aggregate or CDF for purposes of payment. Payment will be made based on the type of backfill actually installed.

The price per linear foot for trench excavation and backfill shall be considered full compensation for the removal, protection, and replacement if damaged or interfering portions of existing sewers, storm drains, waterlines, and other improvements; the plugging or removing of abandoned conduit and structures; the excavations of the trench; disposal of excess excavation; the control of ground and surface waters; the preparation of subgrade; backfilling the trench; removing, stockpiling, and replacing topsoil; and all other work necessary to install the pipe or conduit, complete in place.

Gravity Sanitary Sewers and Storm Drains

When contained in the Proposal, trench excavation and backfill will be paid for on a linear foot basis for type and depth of backfill used, with depth being measured from original ground or paved surface to invert of the pipe. The price bid per linear foot shall include the excavation required to provide space for the pipe bedding and any excavation and backfill necessary to widen the trench for installation of manholes and appurtenances.

For sanitary sewers and storm drains, depth figures shown in the Proposal are inclusive to the nearest 0.1-foot; that is, a trench depth measured as 11.9-feet will be paid for at the unit price for excavation 10 to 12-feet deep. A trench depth measured as 12.0-feet will be paid for at the unit price for excavation 12 to 14-feet deep. Depths measured at less than 8-feet will be included in the base depth of range of 0 to 8-feet. Depth of trench will be measured at intervals of 50-feet along the centerline of the trench, and the ends. Depths will be interpolated between each 50-foot station or the ends if the line is less than 50-feet long.

Pressure Sewers, Waterlines, and Conduits

Payment for trench excavation and backfill will be made at the respective unit prices stated in the Proposal for the trench excavation, the type of backfill used, and all incidental work, including all extra excavation required to provide space for pipe bedding, and shall also include any incidental excavation and backfill necessary to widen the trench for installation of branch-line fittings and appurtenances.

For waterline installations, payment for trench excavation and native backfill will be included within the "Installation of Pipe" bid item, *Subsection 504.01*.

206.04.02 *Rock Excavation*

206.04.02A *Structural Rock Excavation*

Rock excavation will be measured on a cubic-yard basis for the actual quantity removed within the limits of excavation as defined for unclassified excavation. Quantity for payment shall be the amount approved by the Engineer.

206.04.02B *Roadbed and Slope Rock Excavation*

Rock excavation will be measured on a cubic-yard basis for the actual quantity removed within the limits of excavation as defined for unclassified excavation. Quantity for payment shall be the amount approved by the Engineer.

206.04.02C *Trench Rock Excavation*

Rock excavation will be measured on a cubic-yard basis as follows:

Length

Length will be the entire horizontal distance where rock is encountered, measured on a lineal foot basis along the centerline of the trench.

Width

For sewers, storm drains, and water mains, the width for payment of trench rock excavation shall not exceed the inside pipe diameter plus 18-inches, except at manhole locations where the width will be the manhole diameter plus 2-feet where rock is encountered.

Depth

Measurement for depth will be the vertical distance from the top of the rock to the bottom of the rock or a depth that is 6-inches below the sewer pipe, storm drain, water main, or structure, whichever is less. Depth will be measured at intervals of 25-feet for sewers and 50-feet for water mains along the centerline of the trench, beginning at the first location that rock is encountered and ending where the rock stops. The average depth between measuring points will be the depth used for computing depth of rock.

Payment for rock excavation will be based on the unit price per cubic yard stated in the bid and will be paid in addition to the payment for trench excavation and backfill. Payment for rock excavation shall include full compensation for all work necessary to excavate the rock material. No payment will be made for rock excavated below the required grade or outside the widths mentioned above.

206.04.03 *Hard Surface Removal and Replacement for Trenches*

Measurement and payment for the removal and replacement of Portland Cement Concrete pavement, asphaltic concrete pavement and surfaces, curbs, driveways, and sidewalks shall conform to the provisions of *Section 210*.

Payment for removal will be covered under excavation unless specifically stated otherwise in this document.

206.04.04 *Embankment*

Measurement for payment for embankment compacted in place will be made on a cubic yard basis. Computation of volume for payment will be based on field measurement of the actual number of cubic yards constructed within limits shown or directed. Where applicable, this shall be within neat lines of the staked cross section.

No payment will be made for quantities required due to subsidence or settlement of ground or foundation, for settlement of materials within the embankment or for shrinkage, settlement, washout, slippage, or loss regardless of cause, subject to the provisions of *Subsection 107.03*.

Deduction may be made for piers, columns, pipes, or miscellaneous construction features constructed within embankment limits.

Payment shall constitute full compensation for all work and all materials used, whether obtained from the site of work or imported.

Trench excavation, bedding, and backfill placed in the compacted embankment will be paid for separately for the particular item and class of construction.

206.04.05 *Foundation Stabilization*

Payment for this item will be based on the unit price per cubic yard stated in the Proposal. Measurement will be based upon a trench pay width of the nominal pipe diameter plus 18-inches. Payment for this item shall constitute full compensation for all materials, labor, equipment, and incidentals necessary to furnish materials at the site and for placing and compacting it and for the extra depth of excavation required below the pipe base grade structure or roadway to provide for a stable base. This item is to provide for unstable base encountered in

the progress of the work and shall be used only under the direction of the Engineer. Foundation stabilization will only be paid in those areas where the Engineer has given written direction for installation.

206.04.06 *Bedding for Sewers, Water Mains, and Conduits*

Payment for pipe bedding will be included in the lineal foot payment for pipe as specified in *Subsection 301.04* and/or *Subsection 504.01*.

206.04.07 *Pipe Zone Backfill*

Payment for pipe zone backfill will be included in the lineal foot payment for pipe as specified in *Subsection 301.04* and/or *Subsection 504.01*.

206.04.08 *Riprap and Filter Blanket*

Riprap and filter blanket material will be measured for payment on a cubic yard or ton basis only when listed in the Proposal as a separate bid item, or when directed by the Engineer. Measurement will be based upon individual trip tickets of actual truck measure furnished to the Engineer for the cubic yards or tons used under this item. Trip tickets shall be presented to the Inspector for signature on the day the material is delivered. No payment will be allowed on trip tickets not so validated by the Inspector.

Payment for riprap and filter blanket shall include all work necessary to furnish and place the material complete. When not listed in the Proposal, payment for riprap and filter blanket shall be incidental to other items of work.

206.04.09 *Imported Topsoil*

Measurement and payment for the imported topsoil will be made on a cubic yard or ton basis and only when listed in the Proposal as a separate bid item. Measurement will be based upon individual trip tickets of actual truck measure furnished to the Engineer for the cubic yards or tons used under this item. Trip tickets shall be presented to the Inspector for signature on the day the material is delivered. No payment will be allowed on trip tickets not so validated by the Inspector.

Payment for imported topsoil shall constitute full compensation for all work necessary to furnish materials onsite, placing material, and for full compaction in place.

206.04.10 *Shoring Bracing*

Shoring, bracing, and cribbing, including all work and materials expended in furnishing, placing, and removing such shoring, bracing, and cribbing necessary to complete the excavation, shall be considered incidental to the pay item for excavation.

206.04.11 *Dewatering*

Dewatering shall be considered as incidental to and included in the pay item for excavation.

207 BORING AND JACKING

207.01 *DESCRIPTION*

207.01.01 *Boring*

Boring shall include all methods by which a pipe or conduit is pushed or pulled into place and by which the excavation method precludes the stationing of a worker within the pipe or conduit without stopping or removing the excavation equipment.

207.01.02 Jacking

Jacking shall include all methods by which a pipe or conduit is pushed or pulled into place and one or more workers inside the conduit excavate and assist in keeping the conduit on a straight and true grade and alignment.

207.01.03 Permits

Permitter shall designate the owner of railroad tracks or other facilities with prior rights under which a pipe or conduit must be bored or jacked.

All necessary permits for the undercrossing will be obtained by the City.

The operation across the permitter's right-of-way must conform to the requirements of the permitter as outlined in a pipeline crossing agreement made between the permitter and the City. The Contractor shall conform to all requirements of the pipeline crossing agreement. Before work is commenced, the Contractor shall be solely responsible for obtaining and delivering to the permitter a public liability and property damage insurance policy in the amount required in the pipeline crossing agreement. The insurance company writing the policy shall be authorized to do business in the State of Oregon and shall be satisfactory to the permitter. The insurance policy or policies shall be delivered to and remain in the possession of the permitter. If any special agreement is required between the Contractor and the permitter, it shall be completed and signed before the Contractor enters upon or commences work on the permitter's property.

207.02 MATERIALS

207.02.01 Pipe Bedding and Pipe Zone Material

Conform to the requirements of **Section 206** unless otherwise specified in the Contract Documents.

207.02.02 Pipe

Conform to **Section 301** or **Section 502** for the strength, class, and type as shown unless otherwise specified in the Contract Documents.

207.02.03 Casing

Provide casing of size to permit proper construction to the required lines and grades. Casing shall be the type shown in the table below.

Use minimum gauge or wall thickness corresponding to the size of casing selected from the following; however, be responsible for selecting the gauge consistent with the operations and the specified requirements of the permitter.

Diameter Inches	Smooth Steel Pipe Minimum Thickness
12 & under	3/16 ASTM A-53
15 – 24	1/4 ASTM A-53
30 – 36	5/16 AWWA C-201
48 – 78	As specified by the Engineer of Record

Equip jacked casings with nipples at the springline and crown at 10-foot centers when pressure grouting is specified.

207.02.04 *Grout*

Grout for filling the annular space between the carrier pipe and casing pipe shall be a mixture of Portland Cement, sand, and pea gravel proportioned to allow complete filling of the annular space. The mixture shall have a creamy consistency that enables it to be pumped with a concrete pump.

Grout for pressure grouting outside jacked carrier or casing pipe shall be a mixture of Portland Cement (Type 1-P) and water proportioned to allow complete filling of all voids. The maximum allowable slump shall be 5-inches.

207.02.05 *Stainless Steel Bands*

One-half-inch wide by 0.020-inch thick steel bands, or equal.

207.02.06 *Supports, Skids, and Casing Spacers*

Casing spacers shall be used on all pipes within the casing, as manufactured by Cascade Waterworks Manufacturing, or approved equal.

207.03 *CONSTRUCTION*

207.03.01 *General*

Conform to all federal, state and local laws and regulations pertaining to tunneling and specifically to the standards set forth in the Oregon Safety Code for Places of Employment, Chapter 24, Safety Code for Mining, Tunneling and Quarrying, published by the Oregon Industrial Accident Commission, latest revision.

Before the start of the work, submit satisfactory evidence to the Project Manager that all insurance coverage requirements called for by the permitter have been complied with. If required, proposed construction methods and materials shall be submitted to the permitter before the start of construction. Written authorization to proceed from the permitter shall be submitted to the Project Manager before the start of construction.

Prior to starting construction, all required labor, materials, and equipment shall be on the site. Notify all permitters at least 48-hours in advance of working within their right-of-way unless otherwise specified in the permit.

207.03.02 *Excavation*

Excavation shall be unclassified and shall include whatever materials are encountered to the depths as shown or as required. The Contractor will visit the site and make an estimate of the kind and extent of various materials that may be encountered in the excavation.

207.03.03 *Alternate of Jacking or Boring*

Jacking or boring may be allowed in lieu of the open trench method. However, written authorization by the Engineer must first be obtained. The Engineer retains the right to reject either the jacking or boring method without rejecting the other. Authorization by the Engineer shall in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the requirements set forth herein.

207.03.04 *Jacking and Boring*

Equip the leading section of pipe or conduit with a jacking head securely anchored thereto to prevent any wobble or alignment variation during the jacking or boring operation. For jacking, all excavation shall be carried out entirely within the jacking head and no excavation in advance thereof shall be permitted. For jacking, every effort shall be made to avoid any loss of earth outside the jacking head. Remove excavated material from the pipe or conduit as excavation progresses, and do not allow such material to accumulate within the pipe or conduit.

Jack or bore all pipes or conduits to true line and grade. Should any deviation from true line and grade be considered excessive, in the judgment of the Engineer, the Contractor shall correct at no expense to the City.

Should appreciable loss of ground occur during the jacking or boring operations, backpack all voids promptly. Fill all remaining voids upon completion of the operations; such filling or backpacking shall be with grout.

The design of all sewer pipe or conduit is based upon the superimposed loads and not upon the loads resulting from the jacking or boring operations. The Contractor shall be responsible for any increase in pipe strength necessary to withstand jacking or boring loads and grouting.

207.03.05 *Concrete Pipe and Box Section*

Protect the driving ends of concrete pipe or conduit against spalling and other damage. Intermediate joints shall be similarly protected by the installation of sufficient bearing shims to properly distribute the bearing stresses. Remove any section of pipe or conduit showing signs of failure and replace with a new section.

207.03.06 *Smooth Steel Casing*

Join sections of smooth steel casing to be jacked or bored by welding the joints with a continuous weld for full circumference or by other means approved by the Engineer. Provide joints that are capable of resisting the jacking and boring forces without failure.

Brace pipe or conduit installed in a casing to prevent shifting and flotation. Fill the void between the casing and the pipe or conduit with grout, or unless otherwise specified by the Engineer.

If not shown on plans or specified in the Contract Documents, the casing diameter shall be the option of the Contractor. Provide casing of such strength as to withstand the jacking or boring loads and of such diameter to allow filling the void between the pipe or conduit and casing with the approved material.

207.03.07 *Grouting Voids Outside Casing or Carrier Pipe*

After the casing, or carrier pipe where no casing is specified, has been jacked or bored into position, pressure grout to fill all voids outside the casing through the grout holes provided. Start grouting at the springline hole at one end and pump grout until grout appears in the grout hole at the crown; then start grouting through the opposite springline hole until grout appears at the hole in the crown. Next grout through the hole at the crown until grout appears in the next set of holes along the pipe. Plug the holes at the starting point and move to the next set of holes and repeat grouting sequence until full-length of jacked pipe has been grouted. Grouting once commenced at any one point shall be completed without stopping.

Nipples installed in grout holes must be removed and the holes grouted flush with the pipe wall, or nipples should be cut off flush with pipe wall and grouted over, or use flush mount pipe nipples and plugs.

207.03.08 *Cased Pipe*

Provide casing spacers under barrel of pipe, join pipe and slide into casing. Pipe barrel shall bear continuously on spacers. Pipe installation shall conform to applicable requirements in **Section 301** or **Section 502**, including spacers air testing and line and grade.

Spacers shall be center-restrained configured. Spacers shall be 6 to 12-inches from ends of casing and 6 to 12-inches from each side of joints with one spacer at center of pipe lengths.

207.03.09 *Grouting Void Between Carrier Pipe and Casing*

Completely fill the annular space between the casing and the carrier pipe with grout (see **Subsection 205.02.07B**) or as specified. When approved by the Engineer, sand may be used in lieu of grout. Fill the voids by continuously pumping grout from one end of casing pipe until grout appears at the other open end. When grouting, use low pressure grouting equipment. The grouting pressures shall not be greater than the design loads of the carrier pipe. The Contractor shall, at his sole expense, remove and replace any pipe sections that fail during the grouting process.

The ends of the casing shall be sacked and sealed at the ends using wrap around end seals as manufactured by Cascade Waterworks Manufacturing, or approved equal.

207.03.10 *Railroad Crossings*

The right is reserved by the City to require jacking or boring under any or all crossings.

Should open trench construction be required by the City at a railroad crossing, the railroad will take up and relay the tracks at no expense to the Contractor. Submit a schedule of operations to the railroad company and to the City 72-hours before trenching within 20-feet of the railroad right-of-way. Construct the pipe crossing and compact backfill through the track location within 72-hours after the tracks have been removed by the railroad unless otherwise specified.

207.03.11 *Contractor's Responsibility*

The Contractor shall be fully responsible for settlement or deterioration of the finished crossing until a period of two-years after final acceptance by the City.

207.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

207.04.01 *Boring and Jacking*

Measurement and payment for bored and jacked pipe or conduit will be made on a linear foot basis, complete in-place. Payment will include, but is not limited to, all excavation, shafts, portals, jacking pits, backfill, lubricant, grouting voids outside of casing, filling the annular space between the pipe and the casing, pipe casing, and all appurtenances.

Where casing is not required but is used at the option of the Contractor, the casing and the backfill between the pipe or conduit and the casing shall be included in the pay item for boring or jacking as applicable and no separate payment for pipe will be made.

Measurement for jacking and boring will be made on a linear foot basis along the centerline of the pipe or conduit between the limits shown. Jacking and boring extensions beyond the limits shown shall be considered to be for the Contractor's convenience, unless ordered in writing, and measurement and payment for said extension shall be made as if the open trench method of construction had been used.

Final payment for each crossing will be made after the Contractor furnishes a satisfactory release from the permitter stating that all claims for labor and materials have been satisfied and that the Contractor's work across the permitter's right-of-way has been completed to the satisfaction of the permitter.

207.04.02 *Jacking or Boring In Lieu of Open Trench*

Where jacking or boring of a conduit is authorized in lieu of open trench construction, measurement and payment will be made as though the open trench method had been used and will include all the pay items that would have been applicable if the open trench construction method had been used.

208 CONCRETE STRUCTURES

208.01 DESCRIPTION

This section covers Portland Cement Concrete (plain or reinforced; precast or cast-in-place) in bridges, box culverts, retaining walls, catch basins, abutments, piers, footings, foundations, curbs, sidewalks, and similar structures.

208.02 MATERIALS

208.02.01 Portland Cement

Conform to *Section 205*.

208.02.02 Aggregates

208.02.02A General

Use aggregates that conform to requirements of *Section 205* and the additional requirements contained herein.

208.03 CONSTRUCTION

208.03.01 General

When purchasing concrete from others during performance of the Contract, be fully responsible for such concrete conforming to all requirements contained herein.

208.03.02 Mix Design

208.03.02A Classes of Concrete

Classes of concrete shall designate design field strength of concrete in 28-days (PSI) followed by maximum size of aggregate to be used in the concrete, i.e., Class 3300–1–1/2 shall constitute a mix with a compressive strength of 3300psi in 28-days with 1½-inch maximum size aggregate used in that concrete.

Use the class of concrete as specified or shown for each component part of the project. If not so specified or shown, use Class 3300–1–1/2 concrete.

In all precast, prestressed concrete members in the stems of post-tensioned box girders and in all other members where the spacing of reinforcement is less than 2-inches, use 1-inch maximum size aggregate, unless specified otherwise.

208.03.02B Classification and Proportioning of Concrete Mixtures

Before beginning any concrete work, the Contractor shall submit a concrete mix design to the Project Manager.

During progress of the work, if concrete strength and quality, as determined by the test results, fail to attain the requirements specified, suspend all concrete work and make necessary adjustments to obtain required results.

A mix using different proportions or aggregate sizes of any of concrete materials in the mix may be requested by the Engineer. Any requested and authorized alteration to proportions of any of the concrete materials in the mix shall be made at the Contractor's sole expense.

The Contractor shall design the mix to meet the following requirements unless otherwise specified:

1. Entrained air range 3% to 6% (percent by volume)/AASHTO T-152.
2. Slump range 2-inches to 4-inches/AASHTO T-119.
3. When using ¾-inch maximum size aggregate, the fine aggregate shall be between 40% and 48% of the total aggregate used.
4. When using 1½-inch maximum size aggregate, the fine aggregate shall be between 35% and 45% of the total aggregate used.
5. When specified, use a water-reducing admixture in conformance with manufacturer's recommendations.

Tests for strength shall be made in accordance with the following:

Molding concrete specimens in the field – AASHTO T-23

Compressive strength of molded cylinders – AASHTO T-22

Curing of cylinders shall conform to AASHTO T-23 except as modified herein.

208.03.03 Consistency

In general, use a mixture that contains the minimum amount of water consistent with required workability. Consistency of concrete shall be gauged by ability of equipment to properly place it without segregating or honeycombing, and not by the difficulty in mixing or transporting.

208.03.04 Measurement of Materials

Provide facilities for weighing and accurately measure all materials by weight, except water, when batching concrete; weigh fine and coarse aggregates separately. Take representative samples and determine moisture content for each kind of aggregate. Store or handle aggregates so that their water content remains constant during any day's run. Equipment for weighing materials shall provide convenient and positive means of determining quantities in the batch of concrete, and means shall be provided for addition or removal of small quantities of materials to obtain exact weight per batch. Device for measuring water shall show accurately the quantity in gallons and be so designed that the water supply will be automatically cut off while water is being discharged into the mixer. Water shall be assumed to weigh 8.34 pounds per gallon.

208.03.05 Mixing

208.03.05A General

Machine mix all concrete. Ready-mix concrete may be used if it meets all specified requirements herein.

208.03.05B Mixing at the Site

Mix concrete thoroughly in a batch mixer of a size and type that will ensure a uniform distribution of materials throughout the mass.

Equip mixer with adequate water storage and a device for accurately measuring and automatically controlling amount of water used in each batch. Preferably provide mechanical means for recording the number of revolutions for each batch and automatically preventing discharge of mixer until materials have been mixed the required minimum time.

Remove entire contents of the mixer from the drum before materials for a succeeding batch are placed therein. Deposit materials composing a batch simultaneously in the mixer. Do not use any mixer having a rated capacity of less than 1-sack batch. Do not charge a mixer in excess of its rated capacity.

Mix all concrete for a period of not less than 1½-minutes after all materials, including water, are in the mixer. During the period of mixing, operate at a design speed of not less than 14 or more than 20 revolutions per minute.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon cessation of mixing for a considerable period, clean the mixer thoroughly.

The above specification contemplates the use of conventional revolving drum type mixers. Other types may be used with written permission of the Engineer.

208.03.05C *Truck Mixing*

Unless otherwise authorized by the Engineer, use only revolving drum type truck mixers that are watertight and so constructed that concrete can be mixed to ensure a uniform distribution of materials throughout the mass.

Accurately measure all solid materials for concrete in accordance with **Subsection 208.03.04** and charge into the drum at the proportioning plant. Except as subsequently provided, equip the truck mixer with a tank for carrying mixing water. Place only the prescribed amount of water in the tank unless the tank is equipped with a device by which quantity of water added could be readily verified. Mixing water may be added directly to the batch, in which case a tank will not be required. Truck mixers may be required to be provided with means by which the mixing time can be readily verified by the Engineer.

Do not allow any batch in a truck mixer to exceed the maximum rated capacity of mixer as stated by the manufacturer and stamped in metal on the mixer. Continue truck mixing for not less than 70 revolutions or more than 100 revolutions of the drum at the rate of rotation designated by the manufacturer and stamped in metal on the mixer. Commence mixing after all ingredients, including water, are in the drum. Additional mixing, if any, shall be of the rate of rotation as designated by the manufacturer as agitating speed. Begin mixing within 30-minutes after cement has been added to either the water or the aggregate. When cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above 90° F, or when high-early strength Portland Cement is used, reduce this limit to 15-minutes.

208.03.05D *Partial Mixing at Central Plant*

When a stationary mixer is used for partial mixing of concrete (shrink-mixing), mixing time in stationary mixer may be no more than is required to intermingle the ingredients. After transfer to a truck mixer, further mixing at a designated mixing speed will be required only as necessary to meet the requirements for uniformity of concrete as specified for truck mixing.

208.03.05E *Plant Mix*

Conform mixing at a central plant to requirements for mixing at the site.

208.03.05F *Time of Hauling and Placing Mixed Concrete*

Completely discharge and place in the forms all concrete transported to the project in a truck mixer or truck agitator within ninety 90-minutes after the introduction of mixing water to cement and aggregate, or cement to aggregate, or before 250 revolutions of the truck drum or blades, whichever comes first.

Reduce this time during conditions that contribute to accelerated setting of concrete, or when temperature of concrete is 85° F or above.

Add no water to concrete during hauling or before discharge, unless ordered by the Engineer of Record. Engineer of Record shall not generally approve any water addition that increases the slump by more than 1-inch or exceeds the design water-cement ratio.

208.03.05G *Delivery*

Utilize a plant capacity and transportation equipment that are adequate to ensure continuous delivery of concrete during concreting operations and that will provide for proper handling, placing, and finishing of the concrete. Use a rate of delivery such that the interval between batches does not exceed 20-minutes. Methods of delivery and handling concrete shall allow placing with a minimum of rehandling and without damage to the structure or concrete. Time interval may be reduced when deck concrete is being placed. Control delivery of concrete for decks so that deck pour will progress at a rate of not less than 20-feet per hour unless some other rate of pour is specified.

208.03.05H *Retempering*

Mix concrete only in such quantities as are required for immediate use and do not use any that has developed initial set. Concrete that has partially hardened shall not be retempered or remixed.

208.03.06 *Falsework*

For structures requiring poured-in-place concrete superstructures, working drawings and calculations for falsework prepared by the Engineer may be required to be submitted to the City for review. For a guideline on designing formwork and falsework, the Contractor is referred to the current version of the ACI Standard, "Recommended Practices for Concrete Formwork" (ACI 347).

Design and construct all falsework to support the total applied loads with a deflection/span ratio not to exceed 1/500 in any falsework span. Employ screw jacks or hardwood wedges to take up any settlement in formwork either before or during the placing of concrete. Set falsework for post-tensioned structures to carry full dead load and any additional vertical or horizontal loads caused by the prestressing operation.

Contractor is directed to the fact that post-tensioned structures are not self-supporting until post-tensioning is complete and Contractor shall consider this fact in the design, maintenance, and protection of falsework.

208.03.07 *Forms*

Forms shall be constructed for all concrete work. Adjacent surfacing such as asphaltic concrete shall not be used as a form for placing concrete. Make all forms mortar-tight; set them so finished concrete will conform to the proper dimensions and contours; and make them sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Construct and maintain forms to prevent warping and opening of joints.

Design forms to withstand the effects of vibration of concrete as it is placed.

Support deck forms for concrete box girder spans by girder stems. Posts or other supports for deck forms will not be permitted to come in contact with the bottom slab of the box girder.

Make wood forms for concrete surfaces, not subject to backfill, of dressed lumber of uniform thickness with a form liner of an approved type. Wood forms for interior cells of box girders may be made with or without a form liner. Shiplap or S4S boards are acceptable provided forms are mortar-tight. Plywood will be acceptable as a form liner if sufficiently supported. Ensure that all formwork for exposed concrete surfaces is smooth with the grain running in the same direction to give a good finished appearance. Construct metal ties or anchorages within forms to permit their removal to a depth of at least 1-inch from face without injury to the concrete. Where wire ties are permitted, all wires, upon removal of forms, shall be cut back at least ¼-inch from the face of the concrete with chisels or nippers; for green concrete, nippers are necessary. Design all fittings for metal ties so that upon their

removal, cavities that are left will be of the smallest possible size. Fill cavities with cement mortar and leave surface sound, smooth, even, and uniform in color.

Fillet forms at all sharp corners and bevel or draft all projections, such as girders and copings, to ensure easy removal. For narrow walls and columns, where the bottom of the form is inaccessible, leave the lower form boards loose so that they may be removed for cleaning out extraneous material immediately before placing of the concrete.

Keep the forms in place for periods that shall be determined hereinafter. When the forms appear to be unsatisfactory in any way to the Inspector, either before or during the placing of concrete, work shall be stopped until defects have been corrected.

Maintain shape, strength, rigidity, water-tightness, and surface-smoothness of re-used forms at all times. Do not re-use warped or bulged lumber, and do not re-use any forms which are unsatisfactory in any respect. Thoroughly clean re-used forms of all dirt, mortar, and foreign matter.

Treat all forms with form oil or wax or saturate with water immediately before placing concrete. Do not use material that will adhere to or discolor the concrete.

208.03.08 *Removal of Falsework and Forms*

Assume full responsibility for all damage resulting from premature removal of forms. Do not place earth backfill against walls below grade, and do not remove forms and shoring from structural slabs or beams until concrete has reached an actual field strength equal to 75% of the specified 28-day design field strength. Actual field strength shall be determined from field cured test cylinders that shall be cured under conditions equivalent to the most unfavorable conditions for the portions of concrete that the cylinders represent.

Do not use methods of form removal likely to cause over-stressing of the concrete. Remove supports in such a manner as to permit concrete to uniformly and gradually take the stresses due to its own weight.

Remove all form work from cells of concrete box girders to which access is provided and all form work, except that necessary to support deck slab, from the remaining cells of the box girder.

208.03.09 *Weather Limitations*

208.03.09A *General*

The Contractor shall assume full responsibility for the concrete work during any weather conditions, including, but not limited, too hot and cold weather. Any work not in conformance to the Contract Documents may be rejected by the Project Manager. Replacement or repairs shall be at the Contractor's sole expense.

208.03.09B *Hot Weather*

Take special precautions for hot weather in placing, finishing, and curing concrete when the ambient temperature reaches 85° F or higher and whenever relative humidity, wind velocity, or exposure to the sun at lower air temperatures are expected to cause hot weather conditions for the concrete. Specify cool materials for the mix; add additional water to the forms, subgrades, and other areas to be in contact with concrete, but allow no standing water when concrete is placed; schedule work carefully to place and finish concrete as rapidly as possible; reduce evaporation from the concrete with windbreaks, covers, and fog nozzles; and begin curing as soon as possible.

208.03.09C *Cold Weather*

Do not place concrete when ambient temperature is below 35° F. Enclose structure in such a way that concrete and air within the enclosure can be kept above 50° F for a period of 7-days after

placing the concrete. When enclosures are used to maintain specified temperatures, furnish a 24-hour temperature-recording thermometer to record all temperature within the enclosure.

Supply heating apparatus such as stoves, salamanders, or steam equipment and the necessary fuel. When dry heat is used, provide means of maintaining atmospheric moisture. Heat all aggregates and mixing water to a temperature of at least 70° F, but not more than 150° F; aggregates may be heated by either steam or dry heat.

Where practicable, forms insulated with at least 2-inch thick blankets made of fiberglass, rock wool, balsam wood, or similar commercial material capable of maintaining the surface of the concrete at no less than 50° F may be used in lieu of other protection of concrete involving housing and heating. When forms are insulated, protect exposed horizontal surfaces with a similar layer of the insulating materials securely fastened in place. If insulated forms do not maintain proper temperature at the surface of the concrete, use auxiliary protection and heat. The Contractor may also use plastic and straw to protect the concrete. The Contractor will keep the straw confined to the surfaces being protected and clean up all materials as soon as the concrete no longer requires the protection. No staining of the concrete will be accepted due to the use of straw as a method of protection.

208.03.10 *Handling and Placing*

208.03.10A *General*

In preparation for placing of concrete, remove all sawdust, chips, and other construction debris and extraneous matter from interior of forms. Remove struts, stays, and braces, serving temporarily to hold forms in correct shape and alignment prior to placing of the concrete when the concrete has reached a position rendering their service unnecessary. Remove these temporary members entirely from the forms and do not leave them buried in the concrete.

Do not use concrete that does not reach its final position in forms within time stipulated in *Subsection 208.03.05F*.

Place concrete so as to avoid segregation of material and displacement of reinforcement. Do not use long troughs, chutes, and pipes for conveying concrete from mixer to forms.

For open troughs and chutes, use steel or steel lined material. Where steep slopes are required, equip chutes with baffles or make in short lengths that reverse direction of movement. Keep all chutes, troughs, and pipes clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; discharge water used for flushing clear of structure and do not discharge into any sewer or culvert or appurtenances thereto.

When placing-operations would involve dropping concrete more than 3-feet, deposit through an "elephant trunk." Aluminum pipe will not be allowed.

After initial set of concrete, do not jar forms nor place strain on the ends of the reinforcing bars that project.

Thoroughly compact concrete during and immediately after depositing.

Provide compaction by mechanical vibration subject to the following provisions:

1. Use internal vibration or other methods provided herein.
2. Use vibrators of a sufficient type and design, capable of transmitting vibration to concrete at frequencies of not less than 4,500 impulses per minute.
3. Provide intensity of vibration such as to visibly affect the mass of the concrete of 1-inch slump over a radius of at least 18-inches.

4. Provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in forms.

5. Manipulate vibrators so as to thoroughly work concrete around reinforcement and embedded fixtures and into corners and angles of forms.

6. Apply vibration at the point of deposit and in the area of freshly deposited concrete. Insert vibrators and withdraw from concrete slowly. Use vibration of sufficient duration and intensity to thoroughly compact concrete but do not continue so as to cause segregation. Do not continue vibration at any one-point to the extent that localized areas of grout are formed.

7. Make application of vibrators at points uniformly spaced and not farther apart than twice the radius over which vibration is visibly effective.

8. Do not apply vibration directly or through reinforcement to sections or layers of concrete that have hardened to the degree that concrete ceases to be plastic under vibration. Do not use vibration to make concrete flow in forms over distances so great as to cause segregation, nor to transport concrete in forms.

9. Supplement vibration by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with vibrators.

Place concrete in horizontal layers not more than 12-inches thick except as hereinafter provided. When less than a complete layer is placed in one operation, terminate in a vertical bulkhead. Place each layer and compact before the preceding layer has taken initial set to avoid surfaces of separation between the layers. Compact each layer so as to avoid formation of a surface of separation with a preceding layer.

When placing of concrete is temporarily discontinued and after concrete has become firm enough to retain its form, clean off laitance and other objectionable material to a sufficient depth to expose sound concrete. Smooth top surface of the concrete adjacent to forms with a trowel. Where a "feather edge" might be produced at a construction joint, as in the sloped top surface of a wing wall, use inset formwork to produce a blocked out portion in the preceding layer that produces an edge thickness of not less than 6-inches in succeeding layer. Do not discontinue work within 18-inches of the top of any face unless provision has been made for a coping, in which case a construction joint shall be made at the under side of the coping.

208.03.10B *Pumping*

Placement of concrete by pumping will be permitted provided clean equipment is used that is of sufficient size and capacity to satisfactorily handle the concrete mix specified. For discharge line of pump, use steel or rubber pipe. Provide additional cement or additives required to obtain a pumpable mix at the sole expense of the Contractor.

Furnish evidence of backup means of placing structural concrete in the event of failure of equipment during placement.

208.03.11 *Construction Joints*

208.03.11A *General*

Use construction joints only where shown or designated in the Contract Documents, unless otherwise specified. Taper wooden key forms and pre-soak or treat to prevent swelling. When placing operation is interrupted for any reason, place construction joints and provide with keys to resist shear and dowels to develop bond. Construction joints for curbs, gutters, driveways, and sidewalks shall conform to **Subsection 607.03.07**.

208.03.11B *Bonding*

Before depositing new concrete on or against concrete that has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened in a manner that will not leave loosened particles or aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance and saturated with water. At the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating or mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

The placing of concrete shall be continuous from joint to joint. The face edges of all joints that are exposed to view shall be carefully finished true to line and elevation.

208.03.12 *Expansion and Fixed Joints*

Construct all joints according to details shown.

208.03.12A *Open Joints*

Place open joint in locations shown. Construct by insertion and subsequent removal of a template without chipping or breaking corners of the concrete. Do not extend reinforcement across an open joint unless so shown.

208.03.12B *Filled Joints*

Construct poured expansion joints similar to open joints. When pre-molded types are specified, drive nails at about 1-foot on centers through filler to provide anchors into concrete when it is placed. Place pre-molded joint filler in forms in proper rigid position before concrete is poured.

208.03.12C *Steel Joints*

Shape plates, angles, or other structural shapes accurately at the shop to conform to the section of concrete. Fabricate and paint to conform to requirements of these specifications. Take care to ensure that surface in finished plane is true and free of warping. Employ positive methods in placing joints to keep them in correct position during placement of concrete. Opening at expansion joints at normal temperature shall be as shown. Do not impair clearance in any manner.

208.03.12D *Preformed Elastomeric Joint Seals*

Use compression joint seals in the longest practicable lengths for longitudinal joints. In transverse joints, one factory splice will be permitted in joint seals where required length of material in any one joint exceeds manufacturers' standard stock lengths. Make such splices true and smooth on outside surfaces with no offsets of abutting sections and with complete bond on all abutting surfaces. Make joints clean and dry and free of spalls and irregularities that would impair a tight seal in service. Place seals in the joint under compression, as recommended by manufacturer, using a lubricant adhesive as a covering film applied to both sides of the seal just prior to its installation.

For lubricant adhesive material, use a compound of same base polymer as the joint seal with which it is used, blended with a suitable volatile solvent. Lubricant adhesive shall be compatible with joint seal and concrete and be relatively unaffected by normal moisture in the concrete. It shall maintain a suitable consistency at the temperature at which joint seal is installed.

Set seal as shown and make sure it contacts walls of joint throughout its length. Longitudinal elongation of an installed seal by 3% or more of its original length will be cause for its removal and reinstallation.

Remove all lubricant adhesive that comes upon the exposed top of an installed seal before it dries, and remove all seals that show twist, curl, nicks, or other malformation as installed. Seal all ends of preformed elastomeric joint seals with watertight plug prior to installation of joint seal. Use a foam rubber plug or other acceptable closed, cell cellular material that is compressible to 15% of its uncompressed thickness. Plug shall be a minimum of 2-inches in length and be secured in elastomeric joint seal with an adhesive that will ensure a watertight plug.

208.03.13 *Surface Finishing*

208.03.13A *General*

After forms have been removed, carefully point all depressions resulting from removal of form ties, or from other causes, with mortar conforming to **Section 205**. Maintain thorough saturation of concrete surface during pointing and patching. Type of finish to be used shall be as specified or as shown.

208.03.13B *Slab Finishes*

1. **General** – Refrain from excessive use of "jitterbugs" or other special tools designed for the purpose of forcing coarse aggregate away from slab surface. Dusting of surfaces with dry materials will not be permitted. Compact slabs and floors thoroughly by vibration. Round off edges of slabs and tops of walls with a ½-inch radius, steel-edging tool unless specified otherwise.

2. **Monolithic Finish** – Finish by screeding and floating with straightedge to bring surfaces to the required finish elevation shown. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float to a true, even plane with no coarse aggregate visible. Apply sufficient pressure on wood floats to bring moisture to surface. After surface moisture has disappeared, steel trowel concrete to produce a smooth, impervious surface free from trowel marks. Give an additional troweling to surface for the purpose of burnishing. Final troweling shall produce a ringing sound from the trowel. Do not use dry cement or additional water in troweling. Do not use excessive troweling.

3. **Rough Slab Finish** – Finish slabs to receive fill and mortar setting beds by screeding with straightedges to bring surface to required finish plane. Remove all laitance and leave surface clean. Subject to approval, an acceptable aggregate-revealing material may be used and laitance washed off when concrete has set.

4. **Wood Float Finish** – Finish by screeding with straightedges to bring surface to required line as shown. While concrete is still green, but hardened sufficiently to bear cement finisher's weight, work flat surface to a true and uniform plane with no coarse aggregate visible.

5. **Broomed Floor Finish** – Finish concrete as specified for monolithic floor finish above, except omit final troweling, and finish surface by drawing a fine-hair broom lightly across surface broom reservoir roof slab surface in radial direction. Do all other brooming in same direction and parallel to expansion joints; or in cases of inclined slabs, perpendicular to slope.

6. **Power Machine Finish** – In lieu of hand finishing, a power machine may be used for finishing concrete floors and slabs in conformance with directions of machine manufacturer.

208.03.14 *Curing*

Immediately after the final floating, surface finishing, and edging has been completed and while the concrete surface is still moist, cover the entire exposed concrete and cure in accordance with one of the following provisions as specified.

1. Apply membrane-forming compound of the white-pigmented type uniformly to damp concrete by pressure-spray methods at a rate that will form an impervious membrane when tested in accordance with AASHTO T-155.

2. Apply white polyethylene film, waterproof paper, or burlap polyethylene sheets to damp concrete as soon as it can be placed without marring the surface. Place in intimate contact with the surface, extend over and beyond the sides or edges of the slabs or forms, and weight as approved to hold the covering in position as a moisture proof covering. Laps shall be of approved dimensions and design to maintain tightness equivalent to the covering.

Use covering that is best suited to existing conditions. Regardless of which of the above methods the Contractor chooses, keep the curing medium intact and effective for a period of not less than 72-hours after application.

Protect slab concrete exposed to conditions causing premature drying during placing operations by providing wind breaks, fog spray, or by other necessary methods.

208.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

208.04.01 Concrete

Concrete will be measured on a lump sum basis, square yard surface basis, square foot surface basis, or on a cubic yard basis for payment as shown in the Contract Documents. In all cases the part or parts of work to be measured on each basis shall be as shown and as specified.

When reinforcing steel, metal expansion plates, or miscellaneous metal items are not specified or shown as a separate pay item in the Contract Documents, payment for said item is considered to be incidental to the related item of work and no separate payment will be made.

208.04.01A Lump Sum Basis

Measurement and payment will be made on a lump sum basis as shown in the Contract Documents.

208.04.01B Square Yard Surface Basis

Measurement and payment will be made on a square yard surface basis for each class of concrete as shown in the Contract Documents.

208.04.01C Square Foot Surface Basis

Measurement and payment will be made on a square foot surface basis for each class of concrete as shown in the Contract Documents.

208.04.01D Cubic Yard Basis

Measurement and payment will be made on a cubic yard basis for each class of concrete as shown in the Contract Documents.

209 LANDSCAPING AND LANDSCAPE RESTORATION

209.01 DESCRIPTION

This section covers the work necessary for finish grading, addition of topsoil, fertilizer, and weed control, establishment of lawns or grass areas by sod or seeding; and maintenance of lawn or grass areas, mulching,

fertilization, and planting of ground cover; establishment of nursery stock, such as trees, shrubs, and small plants; and maintenance of ground cover and nursery stock, irrigation system, and subsurface drainage.

209.02 MATERIALS

209.02.01 Plants

Names of plants to conform to standardized names of the American Joint Committee on Horticultural Nomenclature. Names of varieties not included therein conform to names generally accepted in the nursery trade. Provide plants that are nursery-grown with habit of growth that is normal for the species, sound, healthy, vigorous, and free from insects, diseases, and injuries and equal to or exceeding measurements specified when measured before pruning with branches in normal position. Provide sizes and methods of handling according to the code of standards recommended by the American Association of Nurserymen (AAN).

209.02.02 Seed

Provide tested grass and legume seed from blue tag stock and from the latest crop available. Deliver each variety or mixture in standard containers labeled in accordance with Oregon State laws and U.S. Department of Agriculture rules and regulations under the Federal Seed Act. Provide with label showing the following: seed variety, percentage of purity, germination, maximum weed content, and date of test (must be within 9-months of date of delivery). Seed must be tested as set forth in the General Seed Certification Standard by the Oregon State University Certification Board. Mold or evidence of container having been wet or otherwise damaged will be cause for rejection of each lot of seed.

209.02.03 Sod

Provide grass sod that is from a certified or approved source, strongly rooted, and free of pernicious weeds. Sod should be composed of several seed varieties excluding blue and bent grass varieties.

209.02.04 Topsoil

Conform to the applicable requirements of *Subsections 206.02.07* and *206.02.08*.

209.02.05 Sand

Conform to the requirements of *Subsection 206.02.03*.

209.02.06 Organic Material for Soil Amendment

Use a peat consisting of natural residue formed by decomposition of reeds, sedges, or mosses from freshwater site. Peat must be free from lumps, roots, and stones and capable of absorbing at least 4-times its dry weight of water. It must contain organic matter not less than 90% on a dry weight basis, and have a maximum moisture content at time of delivery of 65% by weight.

209.02.07 Lime

Provide a lime composed of ground dolomitic limestone not less than 85% total carbonates and magnesium; ground so that 50% passes #100 sieve and 90% passes #20 sieve. Coarser material may be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing #100 sieve.

209.02.08 Subdrains

Use perforated PVC drainpipe. Perforated PVC pipe shall conform to ASTM D-1785, Schedule 40. The perforations shall consist of 2-rows of 2-inch slots. The slots shall be transverse to the axis of the pipe. Two rows of slots shall be 120° on centers. Slot size shall be 0.4-inches.

209.02.09 *Irrigation and Water Systems*

209.02.09A *Pipe*

Use PVC pipe (SDR-PR) conforming to ASTM D-2241 and fittings of PVC with deep socket dimensions conforming to ASTM D-2466.

209.02.09B *Gate Valves*

Install the following gate valves: Up to and including 3-inches with bronze bodies; 4-inches and larger with either bronze or iron bodies, all having bronze stems, bronze seat rings, and bronze disc faces and conforming to ASTM B-62.

209.02.09C *Pressure-Reducing Valves*

Use adjustable, heavy-duty bronze pressure reducing valves. Must have approved stainless steel or monel strainer to permit quick cleaning or replacement without dismantling or removing the valve from the line and with integral or independent union.

209.02.09D *Control Valves*

Provide manual control valves of molded plastic, brass, or bronze for underground installation. Valves shall have cross or slot-type handle for operation with a standard key, a removable bonnet and stem assembly, an adjustable packing gland, a rising stem to assure full opening of the valve, a renewable disc-type washer seat, and an integral or independent union.

Use electrically-operated control valves of molded plastic, bronze, brass, or stainless steel. These shall be of the normally-closed type, having an open or close time greater than 4-seconds, and capable of manual control during power failure. Provide with a motor assembly or operating parts that are removable without disturbing the valve body. Must be all waterproof for underground burial, and with integral or independent union for supply line connection.

209.02.09E *Quick-Coupling Valves*

Supply one-piece or two-piece body-type, locking cap, having body of approved heavy-duty brass or bronze, watertight before and after the coupler is inserted, and designed so that the valve seat is closed before the coupler is removed. Provide valve couplers, keys, and hose swivels of compatible design to quick-coupling valves.

209.02.09F *Risers*

Connect sprinkler heads and quick-coupling valves to PVC pipe water supply lines with PVC pipe risers and with an approved swing joint.

209.02.09G *Backflow Preventers*

Use either reduced-pressure or double-check valve assemblies, as indicated in Contract Documents, of a type and size approved by the City.

209.02.10 *Fertilizer*

Use fertilizer conforming to the recommended content as provided for in **Subsection 209.03.02**. Furnish fertilizer in moisture-proof bags with weight and the manufacturer's certified analysis of the contents showing the percentage for each ingredient. Furnish fertilizer in a dry condition, free from lumps and caking, in a uniform-granular or palletized form of standard commercial grade conforming to all state and federal regulations and to the standards of the Association of Official Agricultural Chemists. Fertilizer may be furnished in bulk form if an approved transfer hopper is provided.

209.02.11 *Mulch and Ground Covers*

Use one or more of the following types of mulch:

1. Organic mulch of clean, ground Douglas fir or hemlock bark graded so that 50% consists of particles larger than ¼-inch, but not exceeding 1-inch, and 20% will pass a #10 sieve.
2. Fiber-glass mulch of approved commercial grade fiber-glass yarn mat.
3. Straw mulch of threshed straw of oats, wheat, or rye, free from seed of noxious weeds or clean salt hay.
4. On steep slopes use approved mesh to reinforce mulch or plantings such as fiber mulch of heavy, twisted jute mesh, or other material as approved, with openings between strands approximately 1-inch square.
5. Spray mulch of a verdyol complex with nontoxic, 100% organic, water-soluble powder-binding agent with silva fiber used in hydraulic seeding operations.

209.02.12 *Tie-Downs*

Use one or more of the following materials as needed:

1. Eye-bolt masonry anchors of galvanized steel with approved lead shield or flush shell for setting into masonry joint or concrete.
2. 2-inch x 2-inch x 96-inch clear, straight cedar wood stakes.
3. 12-gauge pliable galvanized steel wire for guys or for fastening trees to stakes.
4. 2-ply reinforced rubber garden hose for guy wire encasement having a minimum ⅝-inch diameter threaded openings fitted with screw eyes.
5. Zinc-coated turnbuckles with a 6½-inch lengthwise opening and ⅜-inch diameter threaded openings fitted with screw eyes.

209.02.13 *Soil Sterilant*

Soil sterilant shall be approved by the Engineer and shall be applied conforming to manufacturer's recommendations.

209.03 *CONSTRUCTION*

209.03.01 *General*

Conform to the following standards, the manufacturer's and supplier's recommendations and instructions, and to accepted practices in the industry.

209.03.02 *Soil Test*

If directed by the Engineer, have a soil test performed. The test may be performed by any Oregon State University County Extension Agent or by any other approved soils testing laboratory. The soils analysis shall provide a chemical analysis of the soil and recommendations for soil improvement for the vegetation to be grown. The recommendations shall be used to select the particular fertilizer and soil improvement materials to be used prior to planting.

209.03.03 *Lawns and Grass*

209.03.03A *Project Schedule*

Within 20-calendar-days of the date specified for commencement of work, submit for approval a time schedule indicating dates for beginning and completion of the following operations:

1. Delivery of materials
2. Preparation of seedbed
3. Planting grass
4. Maintenance

209.03.03B *Delivery, Handling, and Storage of Sod*

Deliver sod immediately on lifting and after lawn bed is prepared for planting. Protect sod from drying by covering during delivery to protect from sun and wind. Store materials only in designated areas.

If sod is not laid within 2-days of delivery, spread out flat with grass side up in cool place and keep moist. Rolled or stacked sod that becomes yellow will not be accepted.

209.03.03C *Preparation of Subgrade*

After rough grading is completed and before topsoil is spread, apply lime and/or super phosphate, as determined by soil analysis, and mix to a depth of 4 to 6-inches. Conform to manufacturer's recommendations for applying lime and super phosphate simultaneously and schedule application or applications accordingly.

209.03.03D *Subsurface Drainage*

Lay drainage pipe as specified in **Subsection 209.02.08** on firm bed of ¾"-0" crushed rock with minimum fall of 0.5% and located and sized as shown on the plans. Begin laying pipe at the outlet end of the pipeline and proceed up grade. Install PVC drainpipe with slots facing upward. Place pipe at a minimum depth of 24-inches and not any deeper than required to produce minimum fall. Backfill trenches and pipe zone with 1½ to ¾-inch crushed rock to within 4-inches of subgrade. Cover backfill with fiberglass mat or approved material to prevent infiltrations of soil

Complete backfilling of trenches with a 4-inch layer of coarse sand as specified in **Subsection 206.02.03** and tamp for compaction, as approved.

209.03.03E *Topsoil and Finish Grading*

Spread topsoil and soil conditioner over the prepared rough grade using a rubber-tired tractor with grader blade or equivalent, weighing a maximum of 3½-tons. Imported topsoil must be incorporated with at least a 2-inch layer of subsoil. Thoroughly mix the applied materials to a depth of 8-inches using a disc or cultivator over the entire area in two directions at right angles. Rake topsoil areas to a uniform grade so that all areas drain as shown on the plans or as approved. Remove all trash and any stones exceeding 1-inch in diameter from the area to a depth of 2-inches prior to preparation and planting grass.

209.03.03F *Soil Sterilant*

Apply specified soil sterilant at the rate recommended and by the method approved by the manufacturer or as specified in the Contract Documents.

209.03.03G *Seeding*

Plant grass seed only at times when local weather and other conditions are favorable to the preparation of the soil and to the germination and growth of grass seed. Sow grassed areas evenly with a mechanical spreader at the recommended rate and method approved by Oregon Department of Agriculture Extension Service. Method of seeding may be varied as approved; however, the responsibility to establish a smooth, uniformly-grassed area will not be waived. Hydroseeding will be permitted unless otherwise specified.

209.03.03H Sodding

Before sod is laid, correct soft spots and irregularities in grade of the prepared bed, as approved by the Engineer. Lay sod and tamp or roll so that no voids occur. Water sod thoroughly. Complete sod surface true to finished grade, even and firm. On slopes steeper than 1 to 2, fasten sod with wooden pins 6-inches long driven through the sod into the soil, flush with the top of the sod at intervals approved by the Engineer.

209.03.03I Mulching and Protection of Slopes

Mulch all areas with a slope from 5% to 20% by spreading a uniform light cover of straw mulch over the seeded area at a rate of 1½-tons per acre.

In areas with slopes between 20% and 25%, install erosion control netting. In non-turf areas, cover netting with fir bark mulch.

Mulch all areas with a slope steeper than 25% with spray mulch applied at a rate of 15 gallons per 1,000 square feet after wetting the ground, with water penetrating at least 1-inch deep.

Protect new seeded area from pedestrian traffic. Unless otherwise approved by the Project Manager, erect a fence of 6-foot tall steel fence posts spaced 10-feet on center and strung with orange mesh safety fencing.

209.03.03J Maintenance

Begin maintenance immediately after each portion of lawn is planted and continue for 8-weeks after all lawn planting is completed.

Water to keep surface soil moist. Repair washed-out areas by filling with topsoil, fertilizing, and seeding. Replace mulch on banks when washed or blown away. Repair fencing as needed. Mow to 2-inches after grass reaches 3-inches in height, and mow frequently enough to keep grass from exceeding 2½-inches. Weed by local spot application of selective herbicide only after first planting season when grass is established.

209.03.03K Lawn Guarantee

This guarantee is in addition to the standard 2-year warranty period outlined in **Subsection 103.17**. If, at the end of the 8-week lawn maintenance period a satisfactory stand of grass has not been produced, immediately renovate and reseed the unsatisfactory portions of lawn; or when approved, reseed at the beginning of the next planting season. If a satisfactory stand of grass develops by June 1 of the following year, the lawn will be accepted. If the lawn is not accepted, a complete replanting will be required during the ensuing planting season.

A satisfactory stand is defined as a lawn or section of lawn that has:

1. No bare spots larger than 3-square-feet.
2. Not more than 10% of the total area with bare spots larger than 1-square-foot.
3. Not more than 15% of the total area with bare spots larger than 6-inches square.

209.03.03L Inspection for Acceptance (Not applicable to privately financed public improvements)

Submit a written notice 8-weeks after the start of maintenance on the last section of completed lawn. Within 15-days of such written notice the Engineer will make an inspection of the lawn to determine if a satisfactory stand of grass has been produced.

209.03.04 Trees, Shrubs, and Ground Cover

209.03.04A Delivery, Preparation, and Storage

Dig plants designated in the Contract Documents as balled and burlapped with firm, natural balls of earth of diameter and depth sufficient to encompass the fibrous and feeding root system required for full recovery of the plant. Firmly wrap balls with burlap and bind with twine, cord, or wire mesh. Where necessary to prevent breaking or cracking of the ball during the process of planting, or where the tree exceeds 4-inches in diameter, secure the ball to a platform. Meet or exceed the current edition of AAN standards.

Dig bare root plants during dormant period to remove earth with the least possible injury to the fibrous root system. Cover the roots with thick coating of mud immediately after digging by puddling or wrapping in wet straw, moss, or other suitable packing material for protection until delivery.

Furnish container-grown plants with self-established root systems sufficient to hold earth together after removal from the container but not root-bound. Plants shall have grown for at least 3-months in the container with inside diameter specified. Meet or exceed the current edition of AAN standards.

If plants are not in the dormant state, spray with anti-desiccant to cover foliage as recommended by manufacturer prior to digging the plants. During shipment, protect the plants with tarpaulin or other approved covering to prevent excessive drying from the sun and wind.

Cover balls of balled and burlapped plants and containers of container-grown plants that cannot be planted immediately upon delivery with moist mulch to protect from drying. Plant or heel-in bare root plants immediately upon delivery. Water plants as necessary to prevent drying until planted.

Open and separate all bundles of heeled-in bare root plants before the roots are covered. Avoid leaving air pockets among the roots.

209.03.04B Soil Conditioning

After the specified chemical analysis report for topsoil is received, prepare the topsoil mixture for plant pits and beds by thoroughly mixing the approved topsoil with soil conditioner materials, fertilizer, and lime. Thoroughly mix with rotary mixer or other approved method in the following proportions:

Topsoil Classification by Clay Content	Required Mixture			Parts by Volume	
	Topsoil	Sand	Peat	Fertilizer*	Lime
Clay 5 – 10%	4	0	1 lb./CY	(½) lb./CY	(1)
Clay 10 – 15%	2	2	1 lb./CY	(½) lb./CY	(1)
Clay 15 – 25%	2	4	1½ lbs./CY	(½) lb./CY	(1)
*Adjust in accordance with soil test chemical analysis report.					

Store and protect topsoil mixture and other materials at designated area of the site. Protect topsoil mixture from excessive leaching by covering with tarpaulin if stored for more than 6-weeks.

209.03.04C *Planting Procedures*

Within 20-calendar-days after receiving the notice to proceed, submit a time schedule for approval indicating dates for commencement and completion of the following operations:

1. Tagging of plants in the nurseries
2. Survey and staking of plant locations
3. Delivery of topsoil and other materials
4. Digging and preparation of plant pits and beds
5. Delivery of trees and plants to the site
6. Planting of trees and other plants
7. Fertilization and application of pre-emergent herbicide
8. Guying, staking and mulching
9. Completion of work for start of guarantee period

At least 20-days before start of the guarantee period, submit a schedule of proposed maintenance operations indicating the number of man-hours contemplated for each operation by season during autumn, winter, spring and summer.

Locate new planting where shown on plans, except make approved adjustments where obstructions below ground are encountered or where changes have been made in the construction. Place no planting, except ground cover, closer than 18-inches to pavements and structures. Dig plant pits and have soil mixture for planting ready before plants are delivered. Excavate circular pits with vertical sides a minimum of 2-feet greater than the diameter of the ball. For trees, shrubs, and vines, excavate pits to depth sufficient to accommodate ball or roots when plant is set to finished grade. Place 3-inches of compacted soil mixture in the bottom of pit. Set plants upright and face as approved to give the best appearance or relationship to adjacent structures. Remove wire, burlap, and surplus binding from top and sides of balls. Spread roots in normal position. Cut all broken or frayed roots off cleanly. Place prepared soil mixture and compact carefully to avoid injury to roots and to fill voids. When hole is nearly filled, add water as necessary and allow to soak away. Fill hole to finished grade. When directed by Engineer, form shallow saucer around plant by placing ridge of topsoil around edge of pit 2-feet greater than diameter of ball. After ground settles, fill with additional soil to level of finished grade.

Plant trees before surrounding smaller plants and covers are placed. Position trees as shown on plans or, where spacing dimensions or locations are not clear, as approved.

Plant shrubs on centers as shown on plans with spacing adjusted if required to evenly fill bed using specified quantity of plants.

Plant hedges on centers as shown on plans. Excavate trenches a maximum of 4-inches deeper and 12-inches wider than spread of roots or diameter of balls. Make adjustments to spacing if necessary to fill trench evenly with the quantity of plants shown on plans.

Plant ground covers in beds having minimum 8-inches of prepared soil mixture. Treat ground cover beds with soil fumigant, after preparation for planting but before any plants are installed within bed area, to destroy weed seeds. Apply according to manufacturer's directions, delaying planting for the recommended minimum period to allow dissipation of herbicide. Space plants as shown on plans. Mulch and water immediately after planting.

Plant bulbs in ground cover beds to recommended depths for each bulb type as shown on plans.

Provide trees and planting beds with 3-inch layer of fir or hemlock bark mulch within 2-days after planting and keep at this depth throughout maintenance period. Mulch to entirely cover area of saucer around each tree.

Use 4 guys equally spaced as shown on plans for all trees greater than 4-inches in diameter.

Use 3 guys equally spaced as shown on plans for all trees 4-inches in diameter or less.

Where shown on plans, wrap trunks of trees spirally from ground line to height of second branches. Make all wrappings neat and snug and hold material in place by raffia cord at top and bottom.

209.03.04D *Pruning and Repair*

At completion of planting work, prune and repair injuries at all plants. Limit amount of pruning to minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots as a result of planting operations. Do not change natural habit or shape of plant. Make cuts to branch collar leaving no stubs.

209.03.04E *Plant Guarantee*

Guarantee all plants and trees for a minimum of 2-years to be alive and in vigorous growing condition at the end of the guarantee period. Guarantee period shall begin from the date of Acceptance of Work as defined in **Subsection 101.01**. Remove unsatisfactory plants and replace with plants of the same kind, quality, and size as originally specified. Guarantee all plant replacements to be alive and in vigorous growing condition 2-years after replacement. Bear all costs of replacement except for replacements resulting from removal, loss or damage due to occupancy of project in any part, vandalism, or acts of neglect on the part of others. Replace plants that die immediately, unless during a season unfavorable for planting. When season is unfavorable, plant during the first month of the next favorable planting season.

209.02.04F *Maintenance*

Begin maintenance immediately after each plant is installed and continue to maintain until the end of the guarantee period.

Perform the following operations: (1) Watering as often as required to maintain capillary water within 2-inches of the soil surface around plants; (2) Weeding of plant beds, planting saucers, and plant pockets to keep free of weeds using approved selective herbicide according to the manufacturer's directions for use, and/or weeding by hand methods; (3) Mulching monthly to replenish mulch and keep at required 2-inch minimum depth; (4) Tightening and repairing guys to keep trees erect and supported without damage to bark; (5) Resetting plants to proper grades or upright position; (6) Restoration of planting saucers; (7) Seasonal spraying to control disease or insect pests that may impair plant vigor.

Replace plants required by the plant guarantee on a regular monthly basis, except during the months of December, January, and February.

209.03.05 *Irrigation Systems*

209.03.05A *General*

Install components of the irrigation system as shown and as recommended by the equipment manufacturers. All sprinkler run-outs shall be evenly graded to the drain points shown on plans. Piping beneath paved areas and concrete walks shall be installed in PVC sleeves. Construct irrigation system in areas to receive topsoil after topsoil is spread, compacted, and rough graded. Bed PVC pipe in sand as shown on plans and backfill to a minimum of 3-inches above the pipe with sand. Determine the final number and location of sprinkler heads after grading is complete, such that complete coverage of all sprinkled areas is provided. Flush out system thoroughly and pressure test before installing sprinkler heads. Adjust flow on each head for proper coverage.

Repair and replace irrigation parts and winterize as necessary.

209.03.05B *PVC Pipe*

Cut, make up, and install PVC pipe in accordance with the manufacturer's recommendations, as approved. Lay PVC pipe using the practice of snaking from one side of the trench to the other, one cycle per 40-feet or less. Use strap wrenches for tightening threaded plastic joints. Take care not to over-tighten fittings. Do not lay PVC pipe when the temperature is below 40° F. Sprinklers and valves shall be installed in accordance with the manufacturer's recommendations, as approved.

209.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

209.04.01 Incidental Basis

When not specified or shown as a separate pay item in the Proposal, payment for all landscape work is considered to be incidental to the construction.

209.04.02 Unit Price Basis

When so listed in the bid, payment for the landscaping items will be made on a unit price basis for the number of items actually placed and accepted.

209.04.03 Lump Sum Basis

When so listed in the bid, measurement and payment will be made at the contract lump sum pay item for landscaping, complete.

210 RESURFACING

210.01 DESCRIPTION

This section covers the work necessary to replace all pavement, pavement base, curbs, sidewalks, rock surfacing, and other surface features impacted either directly or indirectly by the operations related to the construction of sewers, storm drains, water distribution systems, and conduits.

210.02 MATERIALS

210.02.01 Asphalt Concrete

Use hot mix asphalt concrete ½-inch Level 2 mix conforming to the requirements for hot mix asphalt concrete in *Section 605* and *Section 205*, unless otherwise specified.

210.02.02 Pavement Base

Use pavement base material for resurfacing trenches that conform to *Section 603*.

210.02.03 Forms

All forms shall conform to requirements for forms in *Section 208*.

210.02.04 Rock Surfacing

Rock surfacing shall be 1½-inch or 1”– 0” crushed aggregate as specified in *Section 206.02.05A*.

210.02.05 Subgrade

Subgrade material shall conform to the requirements for subgrade in *Section 601*.

210.03 CONSTRUCTION

210.03.01 Street Maintenance

Maintain all trenches as specified under *Section 206*.

210.03.02 Temporary Hot or Cold Mix Asphalt

All excavations on hard surfaces shall be paved with a temporary hot or cold mix asphalt patch at the end of each workday.

Place and compact temporary hot or cold mix asphalt to a minimum depth of 2-inches over the backfilled and compacted trench areas as specified under *Section 206*. Spread with a mechanical spreading machine or place by hand methods. Distribute into place by means of shovel, or suitable forks, and spread with rakes in a loose layer of uniform density.

After spreading, the mixture shall be thoroughly and uniformly compacted with a power-driven roller capable of providing compression of 200 to 300 pounds per linear inch as soon as raking is complete. Compact areas inaccessible to the roller by tamping. After compaction, the temporary asphalt shall have the minimum thickness specified and shall match the adjacent existing grade. The temporary asphalt patch shall be maintained such that a continuous surface will exist without depressions or potholes.

210.03.03 Pavement Base

Place pavement base to the specified depth; when not specified, place to a compacted depth of 12-inches. Bring the top of the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.

Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95% of the maximum dry density as determined by AASHTO T-180.

210.03.04 Asphalt Concrete Pavement

210.03.04A Tack Coat

Tack coat shall be applied in accordance with *Subsection 605.03.04*.

210.03.04B Asphalt Concrete Placement

Sawcut the existing pavement a minimum of 6-inches from the edge of the existing pavement at the side of the trench. The sawcut shall be a straight line and shall follow lines parallel to the pipe centerline to remove any pavement that has been damaged or that is broken and unsound. The sawcut pavement edges shall be free of irregularities. Provide a smooth, sound edge for joining the new pavement. Asphaltic concrete placement must also comply with requirements of *Subsection 206.03.10B*.

Place the asphalt concrete on the prepared subgrade over the trench to the specified depth, or the depth of the adjacent pavement, whichever is greater. When a prime coat is specified, place asphalt concrete after the prime coat has set. Maximum thickness for any one lift of pavement shall not exceed 3-inches when compacted. The minimum thickness for placement of compacted pavement shall not be less than twice the nominal maximum aggregate size. Spread and level the asphalt concrete with hand tools or by use of a mechanical spreader, depending upon the area to be paved. Bring the asphalt concrete to the proper grade and compact by rolling or the use of hand tampers where rolling is impossible or impractical.

If the existing asphaltic concrete being replaced is pervious asphalt, it must be replaced in kind.

Roll with power rollers capable of providing compression of 200 to 300 pounds per linear inch. Begin the rolling from the outside edge of the replacement progressing toward the existing surfacing, lapping the existing surface at least half the width of the roller. If existing surfacing bounds both edges of the replacement, begin rolling at the edges of the replacement, lapping the existing surfacing at least half the width of the roller, and progress toward the center of the replacement area. Overlap each preceding track by at least half the width of the roller and make sufficient passes over the entire area to remove all roller marks and to produce a smooth, uniform surface. Density requirements for asphalt concrete pavement shall conform to those in **Section 605**.

Finished surface of the new, compacted paving shall be flush with the existing surface and conform to the grade and crown of the adjacent pavement.

210.03.04C Seal Coat

Immediately after the new paving is completed, apply a seal coat of liquid asphalt, conforming to **Subsection 205.02.10**, to all joints between the new and original asphalt pavement. The seal coat shall be a minimum of 3-inches in width and shall be centered on the joint. The liquid asphalt shall be applied such that it completely covers the joint.

Immediately after the liquid asphalt has been applied and before the asphalt has solidified, cover the seal-coat asphalt with clean, dry masonry sand. The sand shall be applied in a layer thick enough to prevent tracking of seal coat. Before opening the street to traffic, the Contractor shall clean up all loose sand.

210.03.04D Surface Smoothness

Surface smoothness must comply with requirements of **Subsection 605.03.20**.

210.03.04E Weather Conditions

Weather conditions must conform to requirements of **Subsection 605.03.12**.

210.03.04F Protection of Structures

Provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, curbs, gutters, posts, guard fences, road signs, and any other structures from splashing oil and asphalt from the surfacing operations. Remove any oil, asphalt, dirt, or any other undesirable matter that may come upon these structures by reason of the surfacing operations.

Where existing structures (e.g., water valve boxes, manholes, catch basins, or other underground utility appurtenances) are within the area to be surfaced, make the resurfacing level with the top of the existing finished elevation of these facilities. The Contractor shall be responsible for adjusting the existing structures as specified in **Section 610**. Consider any delays experienced from such obstructions as incidental to the paving operation. No additional payment will be made. Protect all covers during asphalt application.

210.03.04G Excess Materials

Dispose of all excess materials. Make arrangements for the disposal and bear all costs or retain any profit incidental to such disposal.

210.03.05 *Portland Cement Concrete Pavement*

Pavement replaced shall be the same thickness as that removed, or a minimum of 6-inches, unless otherwise specified. Protect the newly placed concrete from traffic for a period of at least 7-days.

Sawcut the existing pavement a minimum of 6-inches from the edge of the existing pavement at the side of the trench. The sawcut shall be a straight line following lines parallel to the pipe centerline, and shall remove any pavement that has been damaged or that is broken and unsound. The sawcut pavement edges shall be free of irregularities. Provide a smooth, sound edge for joining the new pavement.

If the existing pavement being replaced is pervious concrete, it must be replaced in kind.

Handle, place, finish, and cure concrete pavement in conformance with the applicable provisions of **Section 606**.

210.03.06 *Rock Surfacing*

Place rock surfacing only where shown or directed on streets, driveways, parking areas, street shoulders, and other areas disturbed by the construction. Spread the rock by tailgating and supplement by hand labor where necessary. Level and grade the rock surfacing to conform to adjacent existing grades and surfaces as directed.

210.03.07 *Concrete Driveways, Sidewalks, and Curbs*

Replace concrete driveways, sidewalks and curbs to the same section, width, depth, line, and grade as that removed or damaged. If the existing concrete being replaced is pervious concrete, it must be replaced in kind. Saw broken or jagged ends of existing concrete on a straight line and to a vertical plane. Prior to replacing the concrete sections, properly backfill and compact the backfill to prevent subsequent settlement.

Replace concrete driveways and sidewalks between scored joints unless otherwise directed by the Engineer. Provide a minimum 2-inch thick compacted leveling course of clean $\frac{3}{4}$ "– 0" crushed aggregate. All concrete replacement work shall be completed prior to the placement of adjacent asphalt concrete. Restoration and clean up shall be as specified under **Section 211**.

Construct forms to match existing. Place concrete and finish exposed surfaces similar to adjacent surface in conformance with **Section 607**.

210.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

210.04.01 *Temporary Hot or Cold Mix Asphalt*

Payment for temporary hot or cold mix asphalt pavement placed in all paved areas to be maintained over trench backfill shall be based on the unit price per linear foot stated in the Proposal.

The unit price will include all work and materials required to place and maintain the surface. If not included in the Proposal, then it will be considered incidental to the work and included in the unit price for pavement replacement.

210.04.02 *Rock Surfacing*

Payment for replacement of rock surfacing shall be based on the unit price per ton or cubic yard as stated in the Proposal. The quantity of rock replaced shall be the actual number of tons or cubic yards used as directed by the Engineer, and shall be based on weight tickets from state certified weigh stations. The Contractor will supply certified conversion factors to get from ton to cubic yard. Trip tickets shall be presented to the Engineer for his

signature on the date of use. No payment will be allowed on trip tickets not so validated by the Engineer. The unit price for the rock shall include payment for excavating to provide space for the rock if necessary and disposal of all excess excavated material.

210.04.03 *Asphalt Concrete and Portland Cement Pavement Placement*

Payment for asphalt concrete and Portland Cement Concrete pavement will be based on the unit price per lineal foot stated in the Proposal for each.

The unit prices shall include payment for excavation and dig-out required to provide space for the surfacing and compacted crushed rock, preparation of the trench, surfacing, disposal of all excess excavated materials, temporary cold mix asphalt (if not a separate pay item), and all other work required to complete the resurfacing. The crushed rock base and leveling course, crushed rock for the dig-out area, and seal coat will also be considered as included in the bid price per square yard for pavement replacement as stated in the Proposal.

210.04.04 *Sidewalk and Driveway Replacement*

Payment for sidewalk and driveway replacement will be based on the unit price bid per square foot, as stated in the Proposal. No differentiation will be made between concrete and asphalt sidewalks. All sidewalks and driveways damaged outside of 3-feet of the pipe centerline shall be replaced at the expense of the Contractor.

The leveling course will be considered as included in the bid price for sidewalk and driveway replacement, as stated in the Proposal.

210.04.05 *Curb Replacement*

Payment for replacing concrete curbs, curb and gutter, or gutter sections shall be based on the unit price bid per linear foot as stated in the Proposal. All curbs damaged outside of three feet of the pipe centerline shall be replaced at the expense of the Contractor.

No differentiation for payment will be made between curb and monolithic curb and gutter sections.

210.04.06 *Removal and Replacement of Culverts, Storm Drains, or Catch Basins*

Payment for the removal and replacement of existing culverts or storm sewers lying parallel to and within 3-feet of pipe centerline will be based on the unit price per linear foot, irrespective of size, as stated in the Proposal. Payment shall be considered to include full compensation for all work and material required to remove and replace the pipe and restore the culvert or storm sewer to at least its original condition and function. Replacement of existing culvert headwalls will also be included in this payment.

Payment for removal and replacement of catch basins will be based on the unit price for each, regardless of size or shape, as stated in the Proposal. Payment shall be considered to include full compensation for all work required to remove and replace the catch basins and restore the basins to their original condition and intended function.

211 RESTORATION AND CLEANUP

211.01 *DESCRIPTION*

This section covers the work necessary to restore and clean up the site and remove all construction equipment, refuse, and unused materials of any kind resulting from project activities.

211.02 MATERIALS

Provide all materials required to accomplish the work as specified.

211.03 CONSTRUCTION

211.03.01 Surface Dressing

Slopes, sidewalk areas, planting areas, and roadway shall be smoothed and dressed to the required cross section and grade by means of a grading machine, insofar as it is possible to do, without damaging the work or existing improvements, trees, and shrubs. Unless specified otherwise, the maximum slope shall be 2 to 1 in cut and fill. Supplement machine dressing by hand work as necessary.

Upon completion of the cleaning and dressing, the project shall appear uniform in all respects. Grade all areas true to line and grade as shown. Excavated areas adjoining new walkways and curbs shall be backfilled with topsoil. Where the existing ground is below the sidewalk and curb, fill and dress the area to the walk. Wherever fill material is required in the planting area, make finish surface high enough to allow for final settlement. Surface improvements other than topsoil which are adjacent to new walkways or curbs, such as asphalt paving or brickwork, shall be replaced with like materials.

211.03.02 Removal of Materials

Remove and dispose of all excavated or construction materials, equipment, and trash of all kinds resulting from the work. Where brush and trees have been disturbed, remove and dispose of or restore same as directed by the Engineer at the Contractor's expense.

211.03.03 Cleaning Drains

Clean all drainage facilities such as inlets, catch basins, culverts, and open ditches of all excess material or debris that is the result of the work.

211.03.04 Cleaning Paved Surfaces and Appurtenances

Clean all pavement surfaces, whether new or existing, within the limits of the project. All haul routes will be kept free of dust, dirt, gravel, and debris at all times. Clean all existing improvements, including but not limited to, curbs, gutters, walls, sidewalks, lamp poles, vaults, signs, castings for manholes, monuments, and water valves.

Sweep the street with a vacuum sweeper and hand broom all sidewalks.

211.03.05 Restoring Planted Areas

Hand-rake and drag all former grasses and/or planted areas leaving disturbed areas free from rocks, gravel, clay, or any other foreign material and ready, in all respects, for seeding. The finished surface shall conform to the original surface, be free-draining and free from holes, rough spots, or other surface features detrimental to a seeded area.

211.03.06 Restoring Mobilization, Borrow, and Disposal Areas

Clean all properties that were disturbed during construction of the project. Dispose of all uprooted stumps, felled trees, brush, excess excavation, rock, discarded materials, rubbish, and debris. Remove all plants, equipment, tools, and supplies and restore the property to a neat, clean, and orderly condition in equal or better condition to that existing before move in.

211.03.07 Removal of Signs

Do not remove warning, regulatory, guide, or project signs prior to formal acceptance except as directed.

211.03.08 *Restoring Curbs, Sidewalks, and Driveways*

Repair or replace all curbs, sidewalks, driveways, and other structures damaged during construction of the work. Construct curbs, sidewalks, driveways, and other structures in conformance with the applicable requirements in DIVISION FIVE – TRANSPORTATION TECHNICAL REQUIREMENTS.

211.04 *MEASUREMENT AND PAYMENT* *(Not applicable to privately financed public improvements)*

211.04.01 *Lump Sum Basis*

When restoration and cleanup is listed as a separate pay item on the Proposal, it will be paid for on a lump sum basis.

211.04.02 *Incidental Basis*

When not listed in the Proposal for separate payment, all restoration and cleanup will be considered incidental work for which no separate payment will be made.

****END OF DIVISION****

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301 PIPE AND FITTINGS (SANITARY SEWER)

301.01 DESCRIPTION

This section covers the following work:

- 1 Gravity and pressure sewer pipe
2. Fittings
3. Service branch sewers

301.02 MATERIALS

301.02.01 General

Use all sewer pipe and fittings of the size, strength, material, and joint type specified on the drawings and/or in the Proposal. Use jointing material as hereinafter specified for each pipe material. Each piece of pipe shall be clearly identified as to strength, class, and date of manufacture. The manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements specified herein. Strength, permeability, hydrostatic tests, and pipe joints will be used as the basis of acceptance as described under **Subsection 301.03.12**. Minimum length of pipe shall be 3½-feet.

It is not intended that materials listed herein are to be considered equal or to be generally interchangeable for all applications. The Engineer of Record shall determine the materials suitable for the project and so specify.

Use pipe and fittings for service branches of one type of material throughout; no interchanging of pipe and fittings will be allowed. Use 6-inch diameter pipe for residential services when not otherwise specified.

Do not coat pipes for sewers, internally or externally, with any substance of any type in an attempt to improve its performance when air or hydrostatically tested.

301.02.02 Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to ASTM C-76 Class as shown or specified with Wall B design and the following additional requirements:

1. Cement shall be Type II or Type III conforming to ASTM C-150.
2. The minimum Portland Cement content shall be 564 pounds per cubic yard.
3. The water/cement ratio shall not exceed 0.49.
4. Elliptically reinforcing is not permitted.
5. The Contractor shall provide the Project Manager with a Certificate of Compliance from the pipe manufacturer that the pipe and concrete mix conforms in all respects to these specifications and other non-conflicting requirements of the referenced ASTM specifications.

301.02.02A Joints for Reinforced Concrete Pipe (RCP)

Use rubber gaskets for bell and spigot pipe conforming to ASTM C-443 except as modified herein.

Use captive gasket in groove design for pipe 24-inches diameter and larger.

Use only lubricants for jointing materials approved by the manufacturer.

The following specification is for all concrete sewer pipes with a nominal inside diameter equal to or greater than 24-inches:

A. General – The joint assemblies shall be so formed and manufactured that when the pipe is drawn together in the trenches, the pipe shall form a continuous watertight conduit with a smooth and uniform interior surface, and shall provide for slight movements of any pipe in the pipeline due to expansion, contraction, settlement, or lateral displacement. The rubber gasket shall be the sole element of the joint depended upon to provide water tightness. The ends of the pipe shall be in planes at right angles to the longitudinal centerline of the pipe, except where bevel-end pipe for deflections up to 5° is specified or indicated for bends. Joint faces shall be finished to regular, smooth surface and shall have all surface points within ¼-inches of a theoretical plane taken normal to the pipe axis.

B. Design – The joint design shall be similar to that shown on Standard Details No. 324 or No. 325. The shape and dimensions of the joint shall be such as to provide the following minimum requirements:

1. The rubber gaskets shall be solid gaskets of circular cross section.
2. The gasket shall be confined in a groove in the spigot end of the pipe so that movement of the pipe or hydrostatic pressure cannot displace the gasket. When the joint is assembled, the gasket shall be compressed to form a watertight seal.

3. The volume of the annular space provided for the gasket, with the engaged joint a normal joint closure in concentric position, shall not be less than the design volume of the gasket given on the Joint Data Form Standard Detail No. 325 supplied by the Engineer of Record and approved by the Engineer. The cross-sectional area of the annular space calculated for minimum bell diameter, maximum spigot diameter, minimum width of groove at surface of spigot, and minimum depth of groove. The volume of the annular space shall be calculated considering the centroid of the cross-sectional area to be at the midpoint between the inside bell surface and the surface of the groove on which the gasket is seated at the centerline of the groove.

4. Each gasket shall be manufactured to provide the design volume of rubber required by the joint design used and within a tolerance of $\pm 3\%$ for gaskets up to and including ½-inch diameter and $\pm 1\%$ for gaskets of 1-inch diameter and larger. The allowable percent tolerance shall vary linearly between $\pm 3\%$ and $\pm 1\%$ for gasket diameters between ½-inch and 1-inch.

5. The tolerances permitted in the construction of the joint shall be those stated for joint design on the approved Joint Data Form, Standard Detail No. 325.

6. The taper on all surfaces on the bells and/or spigots on which the rubber gaskets may bear during closure of the joint and at any degree of partial closure, except within the gasket groove, shall not exceed 2°.

The Engineer will utilize the joint data to determine an acceptable joint gap for the particular joint design submitted. The gap will be established by subtracting the settlement allowance, from TABLE 1 below, from the total distance over which the joint may be pulled while meeting the provisions of this specification, or shall be equal to 1½-inches, whichever is smaller.

TABLE 1	
SETTLEMENT ALLOWANCE	
Pipe Inside Diameter Inches	Settlement Allowance Inches
30 or less	3/8
36	1/2
42	1/2
48	5/8
54	5/8

60	$\frac{3}{4}$
66	$\frac{3}{4}$
72	$\frac{7}{8}$
84 or more	1

The surfaces of the bell and spigot in contact with the gasket and adjacent surfaces that may come in contact with the gasket within the specified joint movement range, shall be free from defects.

7. The inside surface of the bell adjacent to the bell face shall be flared to facilitate joining the pipe sections without damaging or displacing the gasket.

8. In all pipes 36-inches or more in diameter, the bell and the spigot of the joint shall contain both circumferential and longitudinal reinforcement. For double-cage pipe, the reinforcement shall be at least equal in area to that of the outside cage or line for bells and the inside cage of line for spigots. For single-cage pipe, the reinforcement shall be at least equal in area to that of the cage for the bell and the spigot. The location of reinforcement shall be subject, however, to the permissible variations in dimensions given in the "position of reinforcement" sections in the appropriate ASTM Standard Specification (C-76, C-655, etc.)

C. Approval of Joints – A detail showing exact dimensions of the joint and diameter of rubber gaskets, including tolerances, and details of the spigot groove, and other required data shall be submitted to the Engineer for approval on Joint Data Form, Standard Detail No. 325. Data must be submitted on City's form.

Any fabrication or procurement of material performed prior to approval of details shall be at the Contractor's risk. Approval of the pipe details by the City shall not relieve the Contractor of any of his responsibility to meet all the requirements of these specifications or of the responsibility for the correctness of the pipe details.

Should a joint gap in the completed sewer line exceed that permissible or should visible leakage exist at the joint, a reinforced concrete closure collar shall be constructed around the joint or the joint shall be re-laid as directed by the Engineer at the Contractor's expense.

Responsibility for checking pipe dimensions and any problems arising there from is the Contractor's.

D. Material for Rubber Gaskets

1. Composition and Properties – The term "rubber gaskets" as used in these specifications shall be construed to include natural rubber or synthetic rubber compound. Rubber gaskets shall be extruded or molded and cured in such a manner that any cross-section will be dense, homogeneous, and free from porosity, blisters, pitting, and other imperfections. The gaskets shall be extruded or molded to the design cross-section diameter shown on the approved Joint Data Form, Standard Detail No. 325, within a tolerance of $\pm 1/64$ -inches or $\pm 1.5\%$ of the diameter, whichever is the larger. The gaskets shall be fabricated from an elastomeric compound having the following physical properties:

Tensile strength, PSI, minimum	1,200
Elongation at break, percent, minimum	350
Shore durometer hardness, Type A	35 to 65
Compression set (constant deflection)	
Percent of original deflection, maximum	25
Change in weight, water immersion, percent	
Maximum (2 days at 158° F)	10

Accelerated aging, oxygen pressure test (48 hours, 158° F, 300psi) or air oven test (96 hours, 158° F):		
	Tensile strength after aging, percent of original, minimum	85

2. Storage – All gaskets shall be stored in as cool a place as practicable, preferably at 70° F or less, and protected from the direct rays of the sun. Gaskets that show evidence of deterioration and other defects, such as surface checking or cracking, will be rejected.

3. Compound Tests

a. Methods of Test – Laboratory tests to determine the physical properties of the rubber gaskets to be furnished under this specification shall be performed on test specimens taken from the finished rubber product; except that, at the option of the pipe manufacturer with the approval of the Engineer, specimens may be furnished in accordance with the appropriate ASTM method:

Tensile Strength and Elongation – Method D-412.

Hardness – Method D-2240 (with the exception of Section 3).
The determination shall be taken directly on the gasket. The presser foot shall be applied on areas that are ¼-inch or greater in thickness. If a sample ¼-inch or greater in thickness is not available in the gasket, thinner samples may be piled up to obtain this thickness.

Compression Set – Method B of Method D-395. The specimens shall be a ½-inch long section of gasket with a minimum diameter of ½-inch, deflected axially. Test conditions shall be 22-hours at 158° F (70° C).

Accelerated Aging – Method D-573. Test conditions shall be 96-hours at 158° F (70° C).

Water Absorption – Method D-471. Use distilled water for the standard test liquid. When a 1-inch wide test specimen cannot be obtained, use the greatest width obtainable from the test sample. Test conditions shall be 48-hours at 158° F (70° C).

Splices – If a splice is made in the fabrication of the gasket, the strength shall be such that the gasket shall withstand 100% elongation over the part of the gasket that includes the splice with no visible separation of the splice. While in the stretched position, the gasket shall be rotated in the spliced area a minimum of 180° in each direction in order to inspect for separation. Any portion of the splice shall be capable of passing a bend test without visible separation. The bend test of circular gaskets is defined as wrapping the portion of the un-stretched gasket containing the splice a minimum of 180° and a maximum of 270° around a rod of a diameter equal to the cross-section of the gasket.

b. Test Reports – The manufacturer shall, if required, furnish certified copies of the test reports of the rubber compound used in all rubber gaskets.

301.02.03 Ductile Iron Pipe

Ductile iron pipe shall be Class 50 or greater, shall be centrifugally cast of 60-42-10 iron, and shall conform to ANSI/AWWA C-151/A21.51. Joints shall normally be push-on, or mechanical joint, conforming to ANSI/AWWA C-111/A21.11. If specified and approved by the City in writing, flanged pipe may be used and shall conform to ANSI/AWWA C-115/A21.15.

Ductile iron pipe shall be lined with cement mortar and seal-coated in accordance with ANSI/AWWA C-104/A21.4.

When specified, tube type polyethylene encasement shall conform to ANSI/AWWA C-105/A21.5.

301.02.04 Polyvinyl Chloride (PVC) Pipe

All PVC pipe and fittings shall conform to ASTM D-3034 SDR 35 and ASTM F-679 standards. Joints shall be bell and spigot joints with a rubber gasket conforming to ASTM D-3212 and ASTM F-477. Additives and fillers, including but not limited to, stabilizers, antioxidants, lubricants, etc., shall not exceed 10 parts per 100 by weight.

Where required for added strength, AWWA C-900 or C-905 may be used.

The Contractor shall use the same material for all pipes and fittings for both the sewer mainline and any service connections between consecutive manholes. Pipe bedding for PVC pipe shall be in accordance with *Section 206*.

301.02.05 High Density Polyethylene (HDPE) Pipe, Solid Wall

Use pipe made from premium high-density polyethylene resin qualified as Type III, Category 5, Class C, Grade P34 as specified in ASTM D-1238. This material shall have a long-term hydrostatic strength of 1,600psi when tested and analyzed in accordance with ASTM D-2837 and shall be listed by the Plastic Pipe Institute as a PE 3408 resin. Pipe sizing is to be according to ASTM F-714 and ASTM D-3035.

The minimum engineering design properties shall be:			
	Tensile Strength Yield	ASTM D-638 (2"/min.)	3,200psi
	Elongation at Break	ASTM D-638	750%
	Modulus of Elasticity	ASTM D-638	105,000psi
	Flexural Modulus	ASTM D-3350	124,000psi
	Environmental Stress Crack Resistance, Condition C	ASTM D-1693	F ₂₀ at >5,000 hrs.
	Long-term Hydrostatic Strength @ 73.4° F	ASTM D-2837	1,600psi

The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.

The polyethylene pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be uniform in color, opacity, density, and other physical properties. The raw material shall contain a minimum of 2%, well dispersed, carbon black. Additives that can be conclusively proven not to be detrimental to the pipe may be also used, provided the pipe produced meets the requirements of this standard.

The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material supplier.

The following information shall be continuously marked on the pipe or spaced at intervals not exceeding 5-feet:

1.)	Name and/or trademark of the pipe manufacturer
2.)	Nominal pipe size
3.)	Standard dimensional ratio (SDR)
4.)	The letters "PE" followed by the polyethylene grade per ASTM D-3350, followed by the hydrostatic design basis in 100's of PSI, e.g., PE 3408
5.)	Manufacturing standard reference, e.g., ASTM F-714
6.)	A production code from which the date and place of manufacture can be determined

Compliance with requirements of these specifications shall be certified in writing by the pipe supplier.

301.02.05A *Joints for HDPE Pipe*

High-density polyethylene (HDPE) pipe and fittings shall be jointed by the thermal butt fusion per ASTM A-2657 and the manufacturer's specific recommendations or approved coupler. The temperature of the heater plate should be 400° F – 450° F. Of additional importance are the interface pressures. The tensile strength at yield of the butt fusion joints shall be not less than that of the pipe.

The HDPE pipe may be adapted to fittings or other systems by means of an assembly consisting of a HDPE stub-end, butt-fused to the pipe, a backup flange of ductile iron made to Class 150, ANSI B1 6.1/B1 6.5 dimensional standards with exceptions, bolts of comparable material, and a gasket of suitable neoprene, red rubber or non-asbestos rubber compound cut to fit the joint. In all cases, the bolts shall be drawn up evenly and in line.

HDPE pipes of the same outside diameter but different wall thickness shall be joined by means of a flange assembly as designated above or by thermal butt fusion, and will only be allowed when expressly approved by the Engineer.

The pipe supplier shall be consulted to obtain machinery and expertise for the joining by butt fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any Contractor until he is qualified in the techniques involved.

301.02.05B *Fittings for HDPE Pipe*

The pipe used to fabricate fittings shall comply with AWWA C-906 and ASTM D-1248 requirements for Type III, Class C, Category 5, Grade P34 polyethylene material. Standard fittings and special fittings shall be manufactured from the same class of material as the pipe and be fully compatible.

Fittings shall be manufactured in accordance with ASTM D-3261. Fabricated fittings shall be pressure-rated to match the system piping.

301.02.05C *Couplings for HDPE Pipe*

Mechanical connections of polyethylene pipe to fittings or other materials shall be by means of flanged connections (flanged coupling adapters and ANSI backup rings rated for the same pressure service as the system piping) or flexible couplings designed for joining polyethylene pipe to polyethylene pipe or to another piping material such as a head PVC coupler as applicable, as approved by the Engineer. Flanged joints shall use bolts of compatible material. Gaskets shall be required when joining to non-polyethylene materials. In all cases, the bolts shall be evenly torqued using a crisscross pattern like the one used to tighten lug nuts on a car wheel. Flanged joints are to be re-torqued after one-hour or more has passed since initial torquing.

301.02.05D *Service Branches*

Tee and wye fittings to connect service branches shall be either molded butt fusion fittings, or molded saddle fusion fittings.

301.02.05E *Connection to Manholes*

Connections to manholes shall be made with approved, cast-in-place, gasketed adapters or other approved equal.

301.02.06 *Polyvinyl Chloride (PVC) Pressure Pipe & Fittings*

PVC pressure pipe and fabricated fittings shall conform to AWWA C-900 Class 100, or as specified, for pipe diameters 4-inches to 12-inches and AWWA C-905 DR 51, or as specified, for pipe diameters 14-inches and above.

301.02.07 *Service Connection Markers*

Service connection markers shall be new 2-inch x 4-inch utility grade lumber, or better, and one piece shall be used. No splicing will be permitted.

301.02.08 *Jointing Materials (Gaskets)*

Only lubricants for jointing materials approved by the manufacturer shall be used.

Furnish to the Project Manager a certified statement from the manufacturer of the gaskets, setting forth the basic polymer used in the gaskets, and results of the tests of the physical properties of the compound. Gaskets shall be shipped in containers with identification of the batch from which the gaskets were fabricated.

301.02.08A *Concrete Pipe*

Rubber gaskets for bell and spigot pipe shall conform to ASTM C-443.

301.02.08B *Ductile Iron Pipe*

Rubber gaskets shall conform to ANSI A21.11/AWWA C111.

301.02.08C *Polyvinyl Chloride (PVC) Pipe*

Rubber gaskets for PVC pipe shall conform to ASTM F-477.

301.02.09 *Fittings*

301.02.09A *General*

Provide tee or wye fittings in the sewer main for service branch sewers. Tees and wyes for service branch sewers shall be a minimum of 4-inches nominal diameter. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. All fittings shall be of the same materials as the pipe. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. Use the same type of joints on all fittings that are used on the main sewer pipe. Tee or wye fittings shall not be closer than 18-inches to any joint or bell of main line sewer.

301.02.09B *Concrete Pipe*

Use only shop fabricated fittings on all concrete pipes.

Submit fabrication details to the Project Manager for shop-fabricated fittings for review prior to delivery of fittings to the job site.

301.02.09C *Ductile Iron Pipe*

Use mechanical-joint, cast-iron fittings conforming to ANSI A21.10/AWWA C110, and a class of at least equal to that of the adjacent pipe. Use push-on fittings of gray cast iron with body thickness and radii of curvature conforming to ANSI A21.10 and joints conforming to ANSI A21.11/AWWA C111.

301.02.09D Polyvinyl Chloride (PVC) Pipe

PVC fittings shall be in conformance with the requirements of ASTM D-3034 SDR 35 and ASTM F-679 as applicable.

Manhole Adapters – PVC pipe shall be connected to sanitary sewer manholes using an approved manhole adapter specifically manufactured for the intended service. PVC pipe manhole adapters shall be Kor-N-Seal, Le-Ron, or equal commercial product. Field fabricated waterstops or improvised adapters such as gaskets stretched over the pipe will not be allowed.

Manhole adapters requiring the use of grout for installation, such as sand collars, shall be bonded, anchored, and finished using an approved non-shrink grout as specified in **Subsection 205.02.07C**. Plain Portland Cement mortar is not acceptable. Sand collars shall be fabricated by an approved manufacturer and not field made. Sand collars shall be coated with an epoxy adhesive compatible with both PVC and concrete grout and coated with aggregate. The installation of the sand collar shall be such that the bell portion of the adapter is adjacent and external to the wall of the manhole, and the spigot shall protrude through and into the manhole 3-inches beyond the interior of the wall of the manhole.

301.02.10 Pipe Coupling Adapters

Rigid couplers (solid sleeves) manufactured to couple PVC pipe will be required when connecting PVC pipe.

When rigid couplers cannot be used, use flexible mechanical compression joint coupling with No. 305 stainless steel bands manufactured by Joints, Inc., Fernco Joint Sealer, or approved equal.

301.02.11 Cleanouts

Pipe for cleanouts shall be of the same material as the main line. Cleanouts shall be of the same size as the line it is serving or shall be 8-inch nominal diameter, whichever is smaller.

301.03 CONSTRUCTION

301.03.01 Excavation and Backfill

Excavation and backfill shall conform to the requirements of **Section 206** as further specified herein.

301.03.01A Excavation

All excavation shall be unclassified unless otherwise specified.

301.03.01B Backfill

301.03.01B1 Off-road Trench Backfill

For public sewer pipe installations outside of dedicated street rights-of-way, or where current or future hard-surfaced improvements shall not be made, native backfill material as specified in **Subsection 206.02.04** for use above the pipe zone may be used.

301.03.01B2 Traffic Area Trench Backfill

For public sewer pipe installations within dedicated street rights-of-way or where current or future hard-surfaced improvements shall be made, select backfill material as specified in **Subsection 206.02.05A**, for crushed gravel, or as specified in **Subsection 206.02.05B**, for controlled density fill, shall be used.

301.03.02 *Line and Grade for Gravity and Pressure Sewers*

Do not deviate from the line or grade, as established by the Engineer of Record, more than ½-inch for line and ¼-inch for grade, provided that such variation does not result in a level or reverse sloping invert. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.

Establish line and grade for pipe by the use of pipe lasers and the Contractor shall check the line and cut from the offset stakes at maximum intervals of 50-feet.

301.03.02A *Line and Grade for Sewer Laterals*

The Engineer will establish line and grade to the tract of land to be serviced by the sewer system. At the pre-selected location of the service branch, a stake will be driven into the ground showing the depth of excavation required at the property line.

Lay the pipe on a straight line and at a 2% grade between the tee or riser and the stake. Lay the pipe by means of a builder's level of good quality and not less than 24-inches in length.

301.03.03 *Pipe Distribution and Handling*

Distribute material on the job no faster than it can be used to good advantage. Unload pipe only by means recommended by the pipe manufacturer. Do not unload pipe by dropping it to the ground. For publicly financed improvement projects, do not distribute more than one week's supply of material in advance of laying, unless approved by the Project Manager.

Pipe shall not be unloaded or stored in the public right-of-way or easement unless it has been certified and accepted by the Engineer. Inspect all pipe and fittings prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are used. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

Use proper implements, tools, and facilities for the safe and proper protection of the work. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipes showing kinks, cracks, buckles, cuts, gouges or any other damage from the job site. Do not drop or dump pipe into trenches.

301.03.04 *Pipe Laying and Jointing of Pipe and Fittings*

301.03.04A *General*

Proceed with pipe laying upgrade with spigot ends pointing in direction of flow. Place pipe in such a manner as to ensure solid bearing between the pipe and the full cross-sectional area of the bedding for the full length of the pipe between joints. Make assembly of the joint in accordance with the recommendations of the manufacturer. Take care to properly align the pipe before forced entirely home. Upon completion of pipe laying, all pipe joints shall be in the "home" position, which is defined as the position where the least gap (if any) exists, when the pipe components that comprise the joint are fitted together as tightly as the approved joint design will permit. Joints with gaps exceeding the normal gap in the "home" position by more than ¼-inch shall be repaired as required by the Engineer at no cost to the City. In cases where gaps exist in joints but do not exceed the normal gap in the "home" position by more than ¼-inch, the Engineer may require repair of the joint if, in his judgment, these detract from the integrity of the joint based upon soil conditions and the intended use of the pipeline.

After installation, prevent movement from any cause, including uplift or floating.

Take special care to prevent movement of the pipe after installation when laid within a movable trench shield.

When laying operations are not in progress, protect the open end of the pipe from entry of foreign material and block the pipe to prevent movement or creep of gasketed joints.

Plug off pipes that are stubbed out for manhole construction or for connection by others by use of a cap or churney (or approved equal) plug designed for that purpose. Such plugs or caps shall be removable and their removal shall provide a bell end suitable for extension of the line.

Provide all rigid sewer pipes, 36-inches or smaller in diameter, entering or leaving manholes or other structures, with flexible joints within 18-inches of the exterior wall. Rigid pipes larger than 36-inches in diameter shall have this flexible joint within a distance from the exterior wall equal to one-half the nominal pipe diameter. If the flexible joint is in excess of the distance specified from the exterior wall, it will be concrete-bedded to the height of $\frac{1}{4}$ pipe inside diameter with a minimum of 6-inches and a maximum of 12-inches required beneath the pipe barrel. Length shall be from structure to back of pipe bell for incoming pipes and from structure to 6-inches from bell of the adjoining pipe for outgoing pipes. Also required will be a #4 rebar mat with three longitudinal bars minimum, cross tied on 12-inch centers beneath the pipe bell, and extended into the structure wall or base or as required by the Engineer. All extra costs will be borne by the Contractor.

When cutting and/or machining of the pipe is necessary, use only tools and methods recommended by pipe manufacturer.

When 3 or more joint gaps exceed the permissible distance as described herein before, or when 3 or more corrections of defective work are necessary between 2 structures, then all pipe between the first and last defect shall be properly re-laid to reduce the total repairs to 2 per structure-to-structure section. This will be done at the Contractor's sole expense.

301.03.04B *Concrete Pipe*

Use rubber ring gasket joints unless mortar joints are specified by the Engineer. When mortared joints are specified, the entire joint for the full circumference of the pipe shall be completely filled with mortar. The surfaces of the pipe joint shall be brushed clean prior to mortaring. Fill the exterior of the joint with mortar and in the case of bell and spigot joints, fill to an angle of 45°.

301.03.04C *Polyvinyl Chloride (PVC) Pipe*

The Contractor shall use the same material for all pipe and fittings for both mainline and house branches between two consecutive manholes, unless otherwise approved by the Engineer.

Connections to manholes shall be made by an approved manhole adapter that is grouted into the manhole wall or poured in place with the manhole base. If the joint at the coupling meets the requirement of a flexible joint as determined by the Engineer, no additional flexible joint within 18-inches of the manhole wall will be required.

House branches shall be connected to mainline PVC sewer pipe with full-line tees or wyes and $\frac{1}{8}$ bends.

301.03.04D *High Density Polyethylene (HDPE) Pipe*

Prior to placing the HDPE pipe, all joints shall be complete except as noted. The full length of each section of pipe shall rest solidly upon the pipe bed. Pipe that has the grade of the joint disturbed after laying shall be taken up and re-laid.

Pipe fusion shall be performed as recommended by the manufacturer and shall not be done in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress, the open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter the pipe or fittings. Pipe ends left for future connections shall be immediately plugged or capped.

HDPE pipe shall be brought to within 5° F of earth temperature prior to cutting to length for placement of tee, elbows, or other fittings.

HDPE pipe shall be joined by the thermal, butt-fusion method or other coupling methods specifically approved by the Engineer prior to installation.

Any jointing shall be only conducted by personnel possessing the qualifications and certifications specified herein. The joining sites shall be cleared and graded, if necessary, to provide enough space for pipe storage and fusion. The site shall be free of rocks, stumps, and other debris that could cut, scar, gouge, or otherwise damage the pipe. The Contractor shall provide a shelter over the joining operation during adverse weather conditions. Particular caution is required to prevent any water from coming in contact with the heater plate.

The Contractor shall be responsible to provide training and instruction for his personnel at no cost to the City. Training shall include, but not be limited to, familiarization with HDPE pipe and fittings, fusion, testing, and installation of pipe. The personnel requiring training includes, but is not limited to, quality control personnel and polyethylene fusion machine operators as applicable for the project. Only instructed personnel will be allowed to perform the installation or supervision of polyethylene fusion joints.

A listing of those authorized for polyethylene fusion work shall be submitted and approved by the Project Manager prior to any installation or work on the HDPE pipe.

The Contractor shall make all training sessions available to City Inspectors and other quality assurance personnel at no charge and shall schedule the training sessions at a date, place, and time agreeable to the City.

301.03.05 *Installation of Service Branch Sewers, Tees, and Wyes*

Install tee and wye fittings and service branch sewers as shown on the Standard Details. Provide pipe-bedding material, compacted to a minimum of 90% of maximum density as determined by AASHTO T-180, under all tees, wyes, and branch fittings extending to the springline of the fittings. Place pipe bedding material on undisturbed native material or compacted foundation stabilization material.

Maximum vertical deflection permissible with any one fitting shall not exceed 45°. No horizontal deflection is allowed.

Provide ends of all service branches and fittings with approved watertight plugs or caps suitably braced to prevent blow-off during internal air testing. Such plugs or caps shall be removable and their removal shall provide a socket suitable for making a flexible joint service connection or extension.

301.03.06 *Service Connection Markers*

After the service branch is installed, block the capped or plugged end and install the 2-inch x 4-inch marker. Extend markers at least 24-inches above the ground surface. Green magnetic tape with "wastewater" in red letters shall be laid 1-foot above the top of the service lateral, wrapped around the cap at the end of the service and brought to the surface wrapped around the 2-inch x 4-inch marker. Paint the top portion of the marker after its installation with first-quality, white, quick-drying enamel. After the paint has dried, use black, quick-drying enamel and neatly indicate the distance from the natural ground surface to the top of the service branch pipe in feet and inches. If curbs are present or to be poured as part of the project, stamp the top of the curb with an "S" over the service branch crossing.

In cases where the service lateral is not perpendicular to the curb, in addition to the "S" stamp on the top of the curb at the crossing, a button marker shall be epoxied to the top of the curb at the location perpendicular to the end of the lateral. The button marker shall indicate the distance from the face of curb to the 2-inch x 4-inch marker. The button marker shall be supplied by the City and installed by the Contractor.

Take precautions during the backfilling operation to ensure the position and location of the marker. If the marker is broken or knocked out of vertical alignment during the backfilling operation, reopen the trench and replace the marker.

301.03.07 Closure Collars

301.03.07A Concrete Closure Collars

Only install concrete closure collars where specified in the Contract Documents. Construct concrete closure collars in conformance with the details provided. Wash pipe to remove all loose material and soil from the surface on which the concrete will be placed. Wet pipe thoroughly prior to placing the collars. Construct forms with materials that will ensure that no concrete shall enter the line. Make entire collar in one placement and do not place collars in water. Concrete closure collars shall be placed using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, the PVC surface shall first be prepared for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, commercial concrete bonding agent shall be applied to the sand surface prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed. Do not backfill the trench until the concrete has sufficient strength.

301.03.07B Flexible Coupling Closure Collars

Use flexible coupling collars only when specified or approved. Couplings must incorporate full length and full diameter stainless steel shear bands. Couplings shall be of the type produced by “Fernco”, “Mission”, or approved equal.

301.03.08 Disconnect and Reconnect Existing Sewer Laterals

When shown or required, disconnect existing sewer laterals from existing wastewater mains and reconnect them to the new mains. The Contractor shall be responsible for locating the existing sewer laterals prior to installing the tee or wye in the new wastewater line. The Contractor shall verify and reconnect all active sewer laterals to the wastewater main line.

301.03.09 Field Fabricated Connections

Field fabricate tees or wyes for required connections when shown or required. Make all field fabricated tees or wyes similar to approved, manufacturer-supplied tees or wyes and provide for a flexible joint at the point of connection to the tee or wye. Do not allow tee or wye to protrude past the inside wall surface of the sewer pipe, and finish the inside wall surface of the sewer pipe to provide a smooth surface for uninhibited flow through the sewer. Fabricate fittings by inserting a stub into a hole cut in the pipe and grout with a non-shrinking grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fabrication details for fittings shall be submitted to the Engineer for review prior to fabrication. Steel reinforcement may be required by the Engineer at no expense to the City. “Insert-a-tees” or equal may be used in lieu of field-fabricated connections if approved by the Engineer.

301.03.10 Cleanouts

Cleanouts will be constructed per the Standard Details. The cleanout will stand vertical and the Contractor will bring compacted bedding material up around the vertical portion of the top. Frames and covers shall comply with requirements of *Subsection 303.02.07*.

301.03.11 Service Risers

The service risers will be constructed with a tee fitting at the main line. If a wye fitting is necessary and approved, then a 1/8 bend will be utilized as part of the assembly replacing the tee. Risers will be avoided whenever possible. Risers less than 5-feet will not be allowed unless approved by the Engineer.

301.03.12 Testing

301.03.12A General

All gravity sanitary sewers including service branch sewers and appurtenances shall successfully pass an air test prior to acceptance and shall be free of leakage.

Manholes shall be tested as specified in **Subsection 302.03.07**.

All pressure sewer force mains shall be tested in accordance with applicable portions of **Section 502**, when not otherwise specified.

Perform the tests in a manner satisfactory to the Engineer. Calibrate gauges for air testing with a standardized test gauge provided by the Contractor at the start of each testing day. The calibration shall also be witnessed by the Inspector; notify the Inspector at least 24-hours prior to each test.

All testing, including but not limited to deflection and air tests and television (TV) inspections, must be passed before final lift of paving can be placed over the pipe.

The City shall make a televised inspection of the sanitary sewer pipe after the Contractor has completed the installation of the sewer pipe, including all backfill, but before deflection and air testing and paving. When the Contractor has jetted and cleaned the sewer pipe, the inspection shall be scheduled by the Contractor with the Inspector. Any defects in material or workmanship shall be satisfactorily corrected at no expense to the City. The Contractor shall re-TV the pipe after any corrections in accordance with **Subsection 301.03.12D** and supply the TV video and the report to the Project Manager for review and approval. This process will repeat until the pipe complies with the specifications prior to paving.

Water and Equipment for Test – The Contractor shall make all arrangements, perform the test, and provide personnel, plugs, and other necessary equipment to complete the tests at no cost to the City except that the initial TV inspection will be performed by the City at the Contractor's expense. The method, equipment, and personnel shall be subject to approval by the Engineer.

Cleaning Prior to Testing and Acceptance – Prior to any testing for acceptance, the Contractor shall jet rod and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand silt, and other foreign material from the system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment. The Contractor shall continue to clean the system until the TV inspection shows no foreign material in the pipe. Engineer's re-inspection may be required if the amount of debris is, in the Engineer's opinion, excessive.

Make tests of sections of constructed sanitary sewer for acceptance only after all service connections, manholes, backfilling, and compaction are completed between the stations to be tested. City may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of sections of sewer and allow connections prior to the whole system being completed.

Repairs – Repair or replace in accordance with **Subsection 301.03.04A**, and in a manner satisfactory to the Engineer, any section of pipe not meeting the air test requirements, deflection test requirements, joint testing requirements, alignment requirements, or that has leakage. Re-rounding of the pipe will only be allowed if approved by the Engineer.

301.03.12B Deflection Test for Flexible Pipe (HDPE and PVC)

In addition to air testing, perform a deflection test for all sanitary sewers constructed of flexible pipe not less than 30-days after the trench backfill and compaction has been completed, unless otherwise specifically approved by the Engineer. The test shall be conducted by pulling an approved solid pointed mandrel having at least 6 vanes through the completed pipeline. The diameter of the mandrel shall be 95% of the internal pipe diameter. Conduct testing on a manhole-to-manhole basis, and only after the manholes have been channeled and the line has been completely cleaned. Locate and repair any sections failing to pass the test and retest the section at the Contractor's sole expense.

301.03.12C Air Testing

301.03.12C1 Standard Air Testing

General

The Engineer may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10psi and an accuracy of 0.01psi. All air used shall pass through a single control panel.

All plugs used to close the pipe for the air test must be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged pipe is under pressure. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the pipe under test at 10psi or less, and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water (inject the air at the upper plug if possible). Use only qualified personnel to conduct the test.

Ground Water

The presence of ground water will affect the results of the test. Determine the average height of ground water over the sewer immediately before starting the test.

In every case, determine the height of the water table at the time of the test by exploratory holes or such other methods satisfactory to the Engineer. The Engineer will make the final decisions regarding test height for the water in the pipe section being tested.

Method

Use the time-pressure drop method for all air testing.

The test procedures are described as follows:

1.	Clean the sewer to be tested and remove all debris where noted.
2.	Wet the sewer prior to testing, if desirable.
3.	Plug all sewer outlets with suitable test plug. Brace each plug securely.
4.	Check the average height of the groundwater over the pipe. The test pressures required below shall be increased 0.433psi for each foot of average water depth over the sewer.
5.	Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0psig greater than the average backpressure of any groundwater that may submerge the pipe.
6.	After the internal test pressure is reached, allow at least 2-minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.
7.	After the temperature stabilization period, disconnect the air supply.
8.	Determine and record the time, in seconds, that is required for the internal air pressure to drop from 3.5psig to 2.5psig greater than the average backpressure of any groundwater that may submerge the pipe.
9.	Compare the time recorded in step 8 with the time required as determined hereinafter.

Acceptance

The tested section will be acceptable if the time recorded in step 8 above is not less than the time in seconds (T) computed by the formula: $T=K/C$

Where:		
K	=	the sum of the computations ($0.011 d^2L$) for each size of pipe and its length in the section
C	=	the sum of the computations ($0.0003882 dL$) for each size of pipe and its length in the section, except that the minimum value for C shall be 1
d	=	inside diameter of the pipe in inches
L	=	length of pipe in feet

Subsequent Failure – Following a successful air test, visible infiltration of ground water in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections at no expense to the City.

301.03.12C2 Joint Air Testing for Sewers with Pipe Diameters Greater than 35-Inches

General

Because of the difficulty of adequately restraining plugs and the inherent danger of air pressure on large surfaces, the Contractor is encouraged to test each individual joint for leakage using a pneumatic joint testing apparatus in lieu of performing the above required pipe section air testing. Such testing apparatus for each pipe size to be tested shall be tested, calibrated, and approved prior to acceptance testing.

The Engineer may, at any time, require a calibration check of the instrumentation used. A pressure gauge having a minimum division of 0.1psi and an accuracy of 0.0625psi shall be used for the check. All air shall pass through a single control panel.

Groundwater

The pressure of groundwater will affect the results of the test. Determine the average height of groundwater over the sewer immediately before starting the test. The method of checking the groundwater height shall be as approved.

Evaluation

The allowable minimum for a drop in the test air pressure from 3.5 to 2.5psi greater than the average backpressure of any groundwater will be the time per unit length, along centerline of pipe, (T) in seconds, from the following table. Minimum time = T. (One foot of groundwater over the top of the pipe adds 0.443psi to the test air pressure.)

Pipe Inside Diameter Inches	Time Per Unit Lengths (along centerline of pipe) Sec./In.
36	11.1
42	12.9
48	14.8
54	16.7
60	18.4
66	20.2
72	22.0

Pipe Inside Diameter Inches	Time Per Unit Lengths (along centerline of pipe) Sec./In.
<i>(Continued)</i>	
78	23.9
84	26.0

Testing

Testing of individual mainline pipe joints shall be done as mainline pipe laying progresses. It is the intent of this specification that a joint test will be made immediately after each mainline pipe section is laid and backfilled, and the joint gap, excluding settlement allowance, is found to be within acceptable tolerances.

At the sole discretion of the Engineer, upon satisfactory installation and testing of the first 10 successive pipe joints of each pipe size, the Contractor may elect to test joints at no greater than 1-work-day intervals instead of making tests after laying each pipe section.

If a joint does not meet the test time established herein, a reinforced concrete closure collar shall be constructed around the joint or the joint shall be reassembled as approved by the Engineer at no expense to the City.

Subsequent Failure – Following a successful air test, visible infiltration of ground water in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections at no expense to the City.

301.03.12D Television Inspection of Sanitary Sewers

Upon completion of all sewer construction, repairs, cleaning, and required tests, notify the Inspector that all lines are ready for TV inspection.

The City may, at its own option, perform a deflection test at the same time it performs its TV inspection.

After being notified, the City shall commence examination of lines. Findings will be recorded. Correct all deficiencies at no expense to the City.

Upon correction of deficiencies revealed by TV inspection, the Contractor will be responsible for providing a TV inspection and verifying repairs at no expense to the City.

The TV inspection shall be conducted by a technical service that is equipped to make audio-visual tape recordings. The audio-visual tape recording shall:

- Be in color VHS format and be continuous from beginning to end of each pipe run
- Be clear, usable, and free of visual distortions; the image in the video shall appear level
- Include a visual footage meter recording on the tape
- Include a voice recording of suspected deficiencies
- Use a 360° pan and tilt camera
- Be performed by experienced personnel trained in locating breaks, obstacles, and service connections by CCTV utilizing a 360° pan and tilt camera
- Identify visually, with audio, and on the written report the location of the beginning and end of each pipe run, the lineal feet of pipe, all deficiencies, the name of the company creating the tape recording, name of the operator, and date and time of the tape recording
- Include a 360° inspection of each joint

- Include a clear view up each lateral connection
- Identify groundwater infiltration sources associated with construction or materials defects

Submit the audio-visual tape and written report to the Engineer for review. Correct all deficiencies that are revealed in the tape and written report. Make an additional TV inspection of repaired pipes at no additional cost to the City. All tapes and written reports shall become the property of the City.

Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified test and inspections on those sections at no expense to the City.

301.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

301.04.01 Sanitary Sewer Pipe

Measurement and payment for sanitary sewer pipe, including gravity sewers, pressure line sewers, and pipe stub-outs from manholes, will be made on a lineal foot basis for the various classes, types, and sizes of pipe listed in the Contract Documents and as actually installed. All pipe, except service branch pipe, will be measured horizontally from center-to-center of manholes or to the ends of the pipe, whichever is applicable. No deductions will be made for fittings or for structures unless specifically called out in the construction drawings or elsewhere in this document.

Measurement and payment for service branch pipe will be made on a horizontal foot basis for the type and size of pipe installed as shown in the Contract Documents. Length will be measured as the horizontal distance, commencing at the point of connection to the tee, wye, manhole, or pipe, as applicable and terminating at the end of the pipe or at the point of reconnection to the existing service branch pipe, including all fittings, measured along the horizontal centerline of the service if risers are not included in the Contract Documents. If risers are included in the Contract Documents as a separate pay item, then the horizontal distance will start at the top of the riser and terminate at the end of the pipe or point of reconnection to the existing service branch.

Payment shall constitute full compensation for the pipe in place, including furnishing, placing, and compacting pipe bedding and pipe zone material, testing, plugs, and the markers for service branch pipe.

Measurement and payment for disconnecting and reconnecting existing service lateral will be made at the unit price for each as shown in the Contract Documents. Payment shall include full compensation for locating the existing service branch, rerouting any flow, making the disconnection, and reconnecting the new service line with the existing service branch. When not shown as a separate item in the Contract Documents, the disconnection and reconnection will be included in the service branch cost.

301.04.02 Service Risers

Measurement and payment for service risers will be made on a lineal foot basis for type and size of pipe installed as shown in the Contract Documents. Length will be measured from the tee at the main line to the bend at the top of the riser. Compensation will include all pipe, fittings, bedding, pipe zone, backfill, labor, and equipment to install the riser complete in place. If no separate item is included in the Contract Documents, then compensation for the riser assembly will be included in the price per foot for the service branch. If a wye and a 1/8 bend are used in place of a tee, payment will begin at the wye at the main line.

The Engineer will determine the length of each riser. That length will be set by the lateral depth requirement at the property line with a 2% slope back to the top of the riser.

301.04.03 Tee and Wye Fittings

Measurement and payment for service tees and wyes installed in the sewer lines will be made at the unit price for each size and type as shown in the Contract Documents. If no item is listed in the Contract Documents, then the tee and wye fittings will be incidental to the service branch and main line installation and no extra compensation will be allowed. Since no deduction will be made under the payment item for pipe for the length

of the tee or wye, the unit price for tee and wye fittings shall include only the additional cost of furnishing and installing the tee or wye fitting over the cost of furnishing and installing an equivalent straight run of pipe. Payment will include full compensation for pipe plugs, stoppers, or caps installed.

301.04.04 *Siamese Connections*

Measurement and payment for Siamese connections will be made at the unit price each as shown in the Contract Documents and actually constructed. Payment shall include installation of the wye, end plugs, miscellaneous fittings, labor, and equipment to install the connection as shown in the Standard Details. If no item for Siamese connections is included in the Contract Documents, then the material, labor, and equipment necessary will be considered incidental to the service branch installation and no extra compensation will be allowed.

301.04.05 *Concrete Closure Collars*

Measurement and payment for concrete closure collars will be made at the unit price each as shown in the Contract Documents and actually constructed. Payment shall include full compensation for all materials, equipment, and labor necessary to complete the work.

301.04.06 *Field Fabricated Connections*

Measurement and payment for field-fabricated connections will be made at the unit price each for the type and size as shown in Contract Documents. Payment shall include full compensation for all materials, equipment, and labor necessary to complete the work.

301.04.07 *Cleanouts*

Measurement and payment for cleanouts will be made at the unit price each for the type and size as shown in the Contract Documents. Payment shall include full compensation for all materials, equipment, and labor necessary to complete the work.

301.04.08 *Other Items*

Measurement and payment for other items not specified above shall be made at either the unit price or lump sum basis for each bid item as shown in the Contract Documents, or the incidental basis for work not listed in the Contract Documents. Payment shall be full compensation for all materials, equipment, and labor necessary to complete the work.

302 MANHOLES AND CONCRETE STRUCTURES

302.01 *DESCRIPTION*

This section covers the work necessary for the construction of the following items:

1. Manholes
2. Drop assemblies
3. Special concrete structures
4. Concrete encasement
5. Anchor walls

303.02 *MATERIALS*

302.02.01 *Base Rock*

Use ¾"-0", 1"-0", or 1½"-0" baserock as approved, conforming to the requirements for aggregate base material in **Subsection 206.02.05**.

302.02.02 Forms

Forms for exposed surfaces shall be steel or plywood. Other surfaces shall be formed by means of matched boards, plywood, or other approved material. Form all vertical surfaces. Trench walls, large rock, and earth shall not be used as form material.

302.02.03 Concrete and Reinforcing Steel

Concrete and reinforcing steel shall conform to **Section 205**.

302.02.04 Cement Mortar

When specified for use, cement mortar shall conform to **Section 205**. Consistency of mortar shall be such that it will readily adhere to the pipe. Mortar mixed for longer than 30-minutes shall not be used.

302.02.05 Manholes

302.02.05A Precast Manhole Sections

Precast manhole sections shall conform to the Standard Details and be in conformance with ASTM C-478. Minimum wall thickness shall be 5-inches. Top and bottom of all sections shall be parallel. Tongue and groove manhole sections will not be allowed.

Provide eccentric cones for all manholes over 4-feet from crown of pipe to rim. Eccentric cone sections shall conform to all the requirements of ASTM C-478, with the exception of the steel reinforcement requirement, and shall have same wall thickness and reinforcement as the riser manhole sections. Eccentric cones shall be designed to withstand AASHTO H-20 loadings.

Flat slab tops with precast grooves reinforced to withstand AASHTO H-20 loadings shall be provided for manholes 4 or fewer feet deep from crown of pipe to rim. Manholes with 2 to 4-feet from crown of pipe to rim shall have eccentric access flat slab tops. Manholes with less than 2-feet from crown of pipe to rim shall have concentric access flat slab tops.

Prior to the delivery on the job site of any size of precast manhole section, yard permeability tests may be conducted at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material that is to be supplied for the job. All test specimens will be mat tested and shall meet the permeability test requirements of ASTM C-14 and ASTM C-497.

302.02.05B Precast Concrete Bases

Manholes, except when placed over existing sewer pipes, shall be constructed using precast, reinforced concrete bases. Construction of precast bases shall conform to the requirements of ASTM C-478. The base riser section shall be integral with the base slab. The riser section shall extend a minimum of 8-inches above the crown of the largest mainline pipe entering the manhole exclusive of drop sewers.

302.02.05C Poured-in-place Manhole Bases

The Contractor may use poured-in-place manhole bases only over existing sewer pipes. Concrete shall conform to **Section 205**.

302.02.05D Manhole Grade Rings

Concrete grade rings for extensions shall be key-lock joint and shall be designed to withstand AASHTO H-20 loadings.

302.02.05E Jointing Materials

Manhole jointing materials shall conform to **Subsection 205.02.09D**.

302.02.05F Manhole Steps

Steps for concrete manholes shall be steel reinforced polypropylene plastic, M. A. Industries, Inc., No. PS-2PFS, or Lane No. P-13850, or approved equal with red reflectorized markers on the top of the step wings. All steps shall be in conformance with ASTM C-478 and ASTM C-497 except that the minimum horizontal pullout load shall be 1,500 pounds. The steel shall be Grade 60, ½-inch deformed reinforcing bar conforming to ASTM A-615. The polypropylene shall conform to ASTM D-4101 Type II. The steps shall be capable of withstanding an impact load of 70 pounds at 20° F without cracking or fracturing.

The entire polypropylene plastic material surrounding the reinforcing steel bar shall be encased monolithically and have a minimum thickness over the steel of 1/16-inch. Excessive voids will be cause to have the steps rejected by the City.

302.02.06 Pipe and Fittings

Conform to requirements of **Section 301**.

302.02.07 Manhole and Cleanout Frames and Covers

303.02.07A General

All castings shall be true to size, weight, and tolerances shown on the Standard Details. Delivered weight shall be ±5% of the specified weight. The bearing seat shall not rock when checked by the test jig. The foundry shall supply all test gauges and shall not subcontract any of the work other than testing procedure, patterns, machining, and cartage. The casting shall not be made by the open-mold method and shall be free of porosity, shrink cavities, cold shuts, cracks, or any defects that would impair serviceability. Repair of defects by welding or by the use of "smooth-on" or similar material will not be permitted. All castings shall be shot or sand blasted and the application of paint or other coating will not be permitted. Each casting shall have directly cast upon it the initials of the manufacturer and the year of the cast. These characters shall be a minimum of 1¼-inch in height and ⅛-inch in relief. The heat number shall be cast upon each casting. The foundry or Contractor shall provide all labor and equipment for handling all castings during testing and inspection.

All manhole frames and covers located outside of the right-of-way shall be tamper-proof.

302.02.07B Materials

Conform to ASTM A-48, Class 30B and AASHTO M-105, Class 30B, with the following modifications and additional requirements:

Tensile Strength	30,000psi
Traverse Strength (1.2 diameter bar 18" centers):	
Load	2,600 – 3,000 lbs.
Deflection	0.22" – 0.34"
Brinell Hardness (as cast)	173 – 200

Where the ASTM A-48 and ASSHTO M-105 specifications differ, the more stringent shall apply.

The foundry shall certify as to the tensile and traverse properties and the brinell hardness.

302.02.07C *Inspection*

The City reserves the right to require a rough transverse bar (size of bar 1.2-inch diameter x 20-inches long) and/or a tensile bar as per ASTM A-48 for each 20 castings, or heat when less than 20 castings are made.

The following tests shall be performed at the City's option in accordance with one or both of the following methods:

Method A shall consist of testing tensile specimens in accordance with ASTM A-48. The Engineer shall be notified at least 24-hours in advance of casting the units and bars so that he may be present at the time of the melt to permit identification of both bars and castings. The test specimens shall be provided and machined by the manufacturer to the dimensions specified for Specimen B of ASTM A-48. Machining of the test specimens shall be at no expense to the City.

Method B shall consist of a proof load test. The cover, when resting in its frame, shall sustain a 40,000 pound vertical load applied through a 1-inch thick x 9-inches x 9-inches ASTM A-36 steel plate on a ¼-inch rubber pad centered on the manhole cover.

The specified loads shall be applied by a calibrated testing machine and held for a period of 1-minute. Upon removal of the load, the test specimens shall be examined for cracks and permanent deformation. Any cracks or permanent deformation shall be cause for rejection.

The testing will be performed by the City at no expense to the City.

Test specimens shall be selected by the Engineer and tested as follows:

1.	Two assembled test specimens shall be proof-load tested for each 20 castings or heat when less than 20 castings are made from one heat (lot).
2.	If the tested specimens of a designated lot pass the test, all of the units of that lot shall be considered as complying with the load requirements.
3.	If either of the tested specimens of a designated lot fails to pass the test, then 5 additional specimens from the same lot shall be selected for testing.
4.	If the 5 additional specimens pass the load requirements of the test, the total number of that lot to be furnished shall be considered as complying with the requirements except that any of the previous test specimens that failed to meet the load test requirements shall be rejected.
5.	If any of the 5 additional specimens fail to meet the load test requirements, the entire lot shall be rejected except for the test specimens that passed the test. All covers that pass this test will be returned. The City will not be responsible for those that fail the test.

302.02.07D *Cap Screws*

Cap screws and washers for tamperproof and watertight manhole covers shall be stainless steel with 60,000psi minimum tensile strength conforming to ASTM A-453.

302.02.08 *Non-shrink Grout*

Conform to requirements of **Subsection 205.02.07C**.

302.02.09 Drop Assemblies

All drop assemblies shall be of the inside-drop type unless specifically approved by the Engineer prior to construction.

302.03 CONSTRUCTION

302.03.01 General

302.03.01A Excavation and Backfill

Conform to applicable provisions in **Section 206**. Backfill around manholes, cleanouts, and other appurtenances shall be of the same quality as the trench backfill immediately adjacent.

302.03.01B Base Rock

Place crushed aggregate base rock and thoroughly compact with a mechanical-vibrating or power tamper.

302.03.01C Foundation Stabilization

If material in bottom of excavation is unsuitable for supporting manholes and other sewer appurtenances, excavate below subgrade as required by soil conditions and backfill to required grade with rock conforming to Foundation Stabilization in **Subsection 206.03.07**.

302.03.02 Manholes

Prepare the soil and base rock for manholes by leveling and compacting to provide a uniform bearing surface. If necessary, install foundation stabilization material as specified in **Subsection 302.03.01C** above.

Manholes over existing sewer pipes shall be constructed using a cast-in-place base. Densify the concrete base by vibrating or working, and screed to provide a level surface for precast riser sections or formed walls. Deposit sufficient mortar on the base to assure watertight seal between base and manhole wall, or place the first precast section of manhole in the concrete base before the concrete has set, if preferred. The precast section shall be properly located and plumb. Stacking additional manhole sections shall be prohibited until the concrete has cured a minimum of 24-hours in moist conditions.

Precast manhole bases, precast riser sections, and other precast appurtenances shall conform to ASTM C-478 and shall be placed plumb.

When placing precast manhole sections, clean the ends of any foreign material prior to placing any jointing material. Then place the jointing material and the next precast section.

Preformed plastic gaskets shall be installed in strict accordance with the manufacturer's recommendation. Only pipe primer furnished by the gasket manufacturer will be approved. When using preformed plastic gaskets, manhole sections with chips or cracks in the joint surfaces shall not be used. Completed manholes shall be rigid and all manholes shall pass the vacuum test. Construct manhole inverts in conformance with the Standard Details and with smooth transitions to ensure an unobstructed flow through manhole. Where a manhole is poured over a section of pipe, the top portion of the pipe to the full width of pipe and diameter of the manhole shall be removed. Smooth and then cover the exposed edges of pipe completely with mortar. Trowel all mortar surfaces smooth. Apply an approved curing compound or use a comparable approved method to cure cement-based grouts and mortar. Chip-out, remove, and replace all defective or cracked mortar.

The inside of all manholes will be grouted smooth on all spaces between rings and on all picking holes.

Holes for installing pipe into precast manhole sections shall be cast-in-place or cored. Making a hole for a pipe in a manhole section by impact-based methods (jackhammer, percussion hammer, etc.) or sawcutting shall not be allowed.

Channels shall be sloped such that the design drop through the manhole is uniformly graded between the inlet and the outlet pipes. When more than one pipe enters a manhole, the lowest inlet pipe will be uniformly graded to the outlet pipe and the other inlet pipes shall uniformly meet the grade of the channel. Channels shall be formed to allow a 3-foot long by 6-inch diameter TV camera to enter all pipes. If at the time of TV acceptance testing it is found that the camera is obstructed from entering any pipe, the Contractor shall, at his sole expense, revise the channels as necessary. Construct cast-in-place channel and shelf in the field in one operation. Finish concrete shelf between channels with a brush. Precast channels will not be allowed.

302.03.03 *Drop Assemblies*

Construct drop assemblies at locations indicated and as shown on the Standard Details. Drop assemblies shall not be constructed for pipes where the invert is less than 2-feet above the invert of the outgoing pipe.

302.03.04 *Pipe Stub-outs from Manholes*

Install stub-outs from manholes at locations as shown on the plans or as required by the Engineer. Pipe connections to manholes shall be grouted watertight with non-shrink grout using an approved commercial concrete bonding agent applied to all concrete surfaces being grouted. Provide watertight manhole adapters for PVC pipe connections. Pipe connections to the cone section of a manhole are prohibited unless specifically approved by the Engineer prior to construction.

302.03.05 *Manhole Grade Rings*

In general, manhole grade rings will be used on all manholes in streets or roads or other locations where a subsequent change in existing grade may take place. Extensions will be limited to a maximum height of 12-inches.

Install appropriate combination of grade rings to a height that will accommodate the finish manhole surface elevation as shown on the plans. Lay grade rings in mortar with sides plumb and tops level. All grade ring joints shall be constructed using an approved commercial concrete bonding agent applied to all cured concrete surfaces being mortared. No joints, necks, frames, or grade rings shall be mortared without an approved bonding agent. Water as a substitute for commercial concrete bonding agent will not be approved. Grade ring extensions shall be watertight.

302.03.06 *Manhole and Cleanout Frames and Covers*

Set frame in a bed of mortar carried over the flange of the frame. In off-road locations the frame and cover shall be set to 1-foot above existing ground. When frames and covers are installed in unpaved vehicular accessways, a 5-foot x 5-foot pad, 4-inches thick of asphaltic concrete, shall be placed to finished grade centered around the frame. In areas to be paved, the frame and cover shall be adjusted to final finish grade after the first lift of AC has been placed and prior to the final lift. The void between the frame and the first lift of AC will be filled with Type B grout conforming to **Section 205**.

302.03.07 *Vacuum Testing*

All sanitary sewer manholes, except those with pipes larger than 24-inches in diameter, shall be tested for acceptance after backfilling, compaction, and paving. Manholes with pipes larger than 24-inches in diameter will only be visually inspected for infiltration.

Manholes shall be vacuum tested as follows:

A. Each manhole may be tested immediately after assembly and prior to backfilling for Contractor information and ease of repair if necessary. Acceptance testing will be accomplished after backfilling and final paving is complete.

B. All lift holes shall be plugged with an approved non-shrink grout. Manhole frame to grade ring or cone connection shall use commercial concrete bonding agent and non-shrink grout.

C. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

D. The test head shall be placed at the inside of the top of the manhole frame and the seal inflated in accordance with the manufacturer's recommendations. The seal at grade rings and frame shall be subject to the test.

E. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter, 75 seconds for 60-inch, and 90 seconds for 72-inch diameter manholes.

F. If the manhole fails the initial test, necessary repairs shall be made with an approved non-shrink, quick setting grout. Re-testing shall proceed until a satisfactory test is obtained.

302.03.08 *Concrete Encasement*

Conform to the requirements shown on the Standard Details and to applicable requirements of **Section 206**. Foundation stabilization, if necessary, shall be completed and the bottom of the trench compacted, as approved. Sides of encasement shall be formed, not poured, against soil or rock unless specifically approved by the Engineer.

Support pipe true to line and grade before and during placement of concrete. Encasement shall be placed in a minimum of 2 lifts. Place concrete starting at the lower end of the encasement. Adequately support the pipe to prevent pipe deflection during concrete placement and initial set.

After concrete encasement has been placed and taken an initial set, cure by covering with well-moistened earth or backfill material.

302.03.09 *Anchor Walls*

See Standard Detail 321. Do not over-excavate in the areas where the anchor walls are to be poured. Construct suitable forms that will allow the downhill wall face to have a full-bearing surface against undisturbed earth. Cure concrete for 5-days before conducting sewer air testing.

302.03.10 *Manhole Steps*

Steel reinforced polypropylene steps are to be installed in precast concrete manhole cones and sections by the manhole manufacture prior to delivery to the job site.

Installation of the steps shall be in accordance with the manufacturer's recommendations and as approved by the Engineer. All steps within a manhole shall be of the same design, type, and size (mixing of unmatched steps within the same manhole is not permitted). Steps shall be aligned vertically and loose steps shall be cause for rejection of the manhole cone or section.

302.03.11 *Cleaning*

Upon completion, clean each structure of all silt, debris, and foreign matter.

302.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

302.04.01 Manholes

Measurement and payment for manholes will be made on a unit price basis for each type shown in the Contract Documents for concrete manholes 0 to 8-feet deep, plus the unit price per foot shown in the Contract Documents for extra depth of manholes over 8-feet. No deduction will be made for depths less than 8-feet. Measurement of manhole depth will be from the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest 1/10-foot. Payment shall include full compensation for all excavation, backfill, materials, labor, and foundation stabilization or base rock when required, steps, manhole frame and cover as required, pipe stubs and plugs, and equipment required to construct the manhole complete-in-place.

No separate payment shall be made for manhole steps. Payment for manhole steps shall be made as part of the installation or modification of manholes.

302.04.02 Drop Assemblies

Measurement and payment for drop assemblies will be made on a unit price basis as shown in the Contract Documents for drop assemblies 2-feet in depth, plus the unit price per foot shown in the Contract Documents for extra depth over 2-feet. No deduction will be made for depths less than 2-feet. Drop assemblies will be vertically measured from the invert of the pipe at the top of the assembly to the bottom of the assembly to the nearest 1/10-foot. Payment shall include full compensation for all materials, labor, and equipment required to construct the work complete-in-place.

302.04.03 Tamperproof and Watertight Manhole Frame and Covers

Measurement and payment for tamperproof and watertight manhole frame and covers shall be considered as incidental to the construction of manholes and no separate payment shall be made.

302.04.04 Concrete Encasement

Measurement and payment for concrete encasement will be made on a lineal foot basis as shown in the Contract Documents for the size pipe to be encased. Length shall be measured along the centerline of the pipe. Payment shall include full compensation for all materials, equipment, and labor required to construct the work complete-in-place.

302.04.05 Anchor Walls

Measurement and payment for anchor walls shall be made on a unit price basis for each unit installed. Payment shall include full compensation for all materials, equipment, and labor necessary to construct the work complete-in-place.

302.04.06 Other Items

Measurement and payment for other items not specified above shall be made at either the unit price or lump sum basis for each bid item as shown in the Contract Documents, or shall be incidental for work not listed in the Contract Documents. Payment shall be full compensation for all materials, equipment, and labor necessary to complete the work.

303 WORK ON EXISTING SANITARY SEWERS

303.01 DESCRIPTION

This section covers the work necessary to join new work to existing, the abandoning of wastewater lines, storm drains, and structures, and adjusting existing utility structures to finished grades, and shall include the requirements of *Sections 301 and 302* unless otherwise modified herein.

303.02 MATERIALS

Conform to requirements of *Section 205* and to the requirements for related work referred to herein.

303.02.01 Prefabricated Inside Drops (Oregon Drops)

This type of connection will only be allowed with prior approval by the Project Manager. Materials proposed to be used in construction shall be submitted to the Project Manager for approval.

303.03 CONSTRUCTION

303.03.01 Excavation and Backfill

Conform to requirements of *Section 206*.

303.03.02 Manholes Over Existing Sewers

Advise Engineer of system for diverting sewage flow and obtain authorization before starting. The Contractor shall be solely responsible for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.

Construct manholes over existing operating sewer lines at locations shown. Perform necessary excavation and construct new manholes in conformance with applicable requirements of *Section 302*.

Manholes shall be constructed over existing concrete sanitary sewers after first cleaning and applying approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole. Manholes shall be constructed over existing PVC sanitary sewers after first applying a dense coating of clean mortar sand to all pipe surfaces that will be in contact with the manhole, using PVC solvent cement. After the cement has cured, commercial concrete bonding agent shall be applied to the sand prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed.

Prevent broken material or debris from entering sewer flow. Maintain flow through existing sewer lines at all times. Protect new concrete and mortar for a period of 7 days after placing. All sanitary sewer manholes shall be vacuum tested in accordance with *Subsection 302.03.07*. Premature breakage into the existing sewer prior to testing shall not excuse the requirement for testing.

303.03.03 Connection to Existing Main

No service branch or building sewer shall be connected to an existing sewer without prior inspection and approval of the pipe for water-tightness and proper construction in accordance with the State plumbing code. Previous use of the service branch or building sewer for septic tank or other application, or absence of usable cleanouts for accessing the building sewer, shall not excuse the requirement for testing except as may be authorized by the State building codes inspector.

Connections of service branches to existing sewers shall be made watertight. Connection shall be made where possible to existing tees or wyes previously installed and plugged. The plug shall be removed and connection made in accordance with the applicable portions of this section. Transition couplings between dissimilar pipe materials shall be made using approved commercial adapters with stainless steel bands such as Fernco, Caulder, or equal.

Where tees or wyes for connection are absent or unusable, connection of service branches shall be made with an approved tap such as Sealtite saddle, insert-a-tee, or equal commercial tap.

All taps shall be inspected and approved by the Inspector prior to covering.

Taps shall be installed without protrusion into or damage to the existing sewer. No compromise of the sewer will be allowed, such as undermining and settlement of the sewer grade, debris in the sewer, or longitudinal or transverse cracking of the sewer pipe. Any necessary repairs will be at the Contractor's sole expense. If it is necessary to cut in a tee, rigid couplers shall be used on both sides of the tee.

303.03.04 *Removal of Existing Pipes, Manholes, and Appurtenances*

When sewers are extended from cleanouts, the entire cleanout assembly, including the wye, shall be removed.

Existing pipelines, manholes, and appurtenances that lie in the line of and are to be replaced by the new construction shall be removed from the site and disposed of as provided for in **Section 204**.

303.03.05 *Filling Abandoned Manholes, Inlets, and Catch Basins*

Existing structures shown to be abandoned shall be filled with granular material as specified in **Section 206**. Compact to at least 90% maximum density as determined by AASHTO T-180. Remove structure frame and cover or grate and plug all pipes with permanent plugs as specified. Break or perforate the bottom to prevent the entrapment of water.

303.03.06 *Existing Manhole Frames and Covers*

Manhole frames and covers removed by the Contractor that will not be reused on the project shall become the property of the City. Notify the Engineer a minimum of 1-day prior to removal to arrange for picking up the removed frames and covers.

303.03.07 *Permanent Plugs*

Clean interior contact surfaces of all pipes to be cut off or abandoned. Construct concrete plug in end of all pipe 18-inches or less in diameter. Minimum length of concrete plugs shall be 8-inches. For pipe 21-inches and larger, the plugs may be constructed of common brick or concrete block. Plaster the exposed face of block or brick plugs with mortar. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage. Where required by the Engineer, abandoned pipes may be required to be filled with grout or CDF.

303.03.08 *Adjusting Existing Structures to Grade*

Existing manholes, inlets, catch basins, and similar structures shall be brought to the specified finished grade by methods of construction as required in **Section 610**.

303.03.09 *Reconstruct Manhole Base*

Conform to applicable requirements of **Section 302**. Exercise caution in chipping out existing concrete base to prevent cracking of manhole walls. Prevent all material from entering the sewer flow. Pour new base to a minimum of 6-inches below the lowest projection of the pipe. Construct new channels to the elevations

shown. Conform to details for channel construction in the Standard Details. Repair any cracks that occur, as a result of work operations, with new grout to form a watertight seal.

303.03.10 *Connect Pipe to Existing Inlets*

Conform to applicable requirements of **Section 302**. Sawcut opening in inlet with a concrete saw and grout in a watertight seal between the new pipe and inlet wall. Plaster mortar smooth inside pipe opening. Alignment, slope of pipe, and other construction details shall be as specified.

303.03.11 *Connection to Existing Manholes*

All sanitary sewer pipe connections, including those at invert level and penetrations for drop connectors, conduits, and pass-throughs, shall conform to the requirements of applicable portions of **Sections 301 and 302**.

303.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

303.04.01 *Manholes Over Existing Sanitary Sewers*

Measurement and payment for manholes over existing sanitary sewers or storm drains will be made at the unit price for each. Payment will include compensation for excavation and backfill, constructing manhole over existing sewer complete-in-place, final adjustment to grade, maintaining flow, and forming new flow channel.

303.04.02 *Removal of Existing Pipes, Manholes, and Appurtenances*

Payment for removal and disposal of existing pipes, manholes, and appurtenances will be considered as incidental to the work and included in the bid item for excavation and backfill as specified in **Section 206**.

303.04.03 *Connection to Existing Manholes*

Measurement and payment for connection to existing manholes will be made on a unit price each basis. If no item is included in the Contract Documents for “connection to existing manholes”, all costs will be considered incidental work for which no separate payment will be made.

303.04.04 *Prefabricated Inside Drops (Oregon Drops)*

Measurement and payment for prefabricated inside drops will be made on a unit price each basis.

303.04.05 *Filling Abandoned Manholes*

Measurement and payment to filling abandoned manholes will be made on a unit price each basis.

303.04.06 *Adjusting Existing Structures to Grade*

Measurement and payment for adjusting existing manholes, cleanouts, and similar structures will be made on a unit price each basis for the type shown in the Contract Documents. If no item is included in the Contract Documents for “adjust existing structures to grade”, all costs will be considered incidental work for which no separate payment will be made.

303.04.07 *Reconstruct Manhole Base*

Measurement and payment for reconstructing manhole base will be made on a unit price each basis. If no item is included in the Contract Documents for “reconstruct manhole base”, all costs will be considered incidental work for which no separate payment will be made.

303.04.08 *Other Items*

Measurement and payment for other items not specified above shall be made at either the unit price or lump sum basis for each bid item as shown in the Contract Documents, or incidental for work not listed in the Contract Documents. Payment shall be full compensation for all materials, equipment, and labor necessary to complete the work.

****END OF DIVISION****

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401 PIPE AND FITTINGS (STORM DRAINS)

401.01 DESCRIPTION

This section covers the following work:

1. Gravity storm sewer pipe
2. Fittings

401.02 MATERIALS

401.02.01 General

Use all storm sewer pipe and fittings of the size, strength, material, and joint type specified on the Standard Details and/or the Contract Documents. Use jointing material as hereinafter specified for each pipe material. Each piece of pipe shall be clearly identified as to strength, class, and date of manufacture. The manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements specified herein. Strength, permeability, hydrostatic tests, and pipe joints will be used as the basis of acceptance as described under **Subsection 401.03.09**. Minimum length of pipe shall be 3.5-feet.

It is not intended that materials listed herein be considered equal or generally interchangeable for all applications. The Engineer of Record shall determine the materials suitable for the project from the approved pipe materials and so specify.

Use one type of pipe and fittings material throughout; no interchanging of pipe and fittings will be allowed.

Do not coat pipes for storm sewers internally or externally with any substance of any type in an attempt to improve its performance when air tested.

401.02.02 Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to requirements of **Subsection 301.02.02**.

401.02.03 Ductile Iron Pipe

Ductile iron pipe shall conform to requirements of **Subsection 301.02.03**.

401.02.04 High Density Polyethylene Pipe (HDPE)

Smooth interior, corrugated exterior HDPE pipe and associated HDPE fittings shall be watertight and shall conform to AASHTO M-252 and AASHTO M-294. All smooth interior corrugated exterior pipe shall be bell and spigot type pipe.

Solid wall HDPE pipe shall conform to the requirements of **Subsection 301.02.05**.

401.02.05 Aluminized Steel Type II Spiral Rib Pipe

Aluminized steel Type II spiral rib pipe and watertight coupling bands of the gauges and types as shown or specified shall conform to ASTM A-929, ASTM A-760-Fabrication, ASTM A-762, ASTM A-849, or ASTM A-798.

Use prefabricated, aluminum flared-end sections conforming to AASHTO M-197.

All risers shall be manholes conforming to *Subsection 602.03.02*.

401.02.06 *Jointing Materials (Gaskets)*

Jointing materials shall conform to *Subsection 301.02.08*.

401.02.06A *Reinforced Concrete Pipe*

Rubber gaskets shall conform to *Subsection 301.02.08A*.

401.02.06B *Ductile Iron Pipe*

Rubber gaskets shall conform to *Subsection 301.02.08B*.

401.02.06C *HDPE Pipe*

Rubber gaskets for HDPE pipe shall conform to ASTM D-3212.

401.02.06D *Aluminized Steel Type II Spiral Rib Pipe*

Closed cell neoprene sleeve gaskets shall conform to ASTM D-1056, per the pipe manufacturer specifications.

401.02.07 *Couplings, Bands, and Fittings*

401.02.07A *HDPE Pipe*

HDPE bell and spigot couplings, or equivalent, shall conform to ASTM D-3212.

401.02.07B *Aluminized Steel Type II Spiral Rib Pipe*

Use couplings, bands, and fittings conforming to the pipe manufacturer's specifications. All joints shall be watertight.

401.03 *CONSTRUCTION*

401.03.01 *Excavation and Backfill*

Conform to the requirements of *Subsection 301.03.01*.

401.03.02 *Line and Grade for Gravity Storm Sewers*

Line and grade gravity storm sewers shall conform to *Subsection 301.03.02*.

401.03.03 *Pipe Distribution and Handling*

Pipe distribution and handling shall conform to *Subsection 301.03.03*.

401.03.04 *Pipe Laying and Jointing of Pipe and Fittings*

401.03.04A *General*

Pipe laying and jointing of pipe and fittings shall conform to *Subsection 301.03.04A*.

401.03.04B Concrete Pipe

Concrete pipe joints shall conform to *Subsection 301.03.04B*.

401.03.04C Aluminized Steel Type II Spiral Rib Pipe

Installation of all aluminized steel Type II spiral rib pipe shall conform to ASTM A-798 per manufacturers specifications. Installation shall provide end plate stiffeners per manufacturers specifications, including end plate thickness, spacing and configuration, weld specifications, and end-cap-to-pipe weld specifications.

401.03.05 Service Connection Markers

After the service branch is installed, block the capped or plugged end and install the 2-inch x 4-inch marker. Extend markers at least 24-inches above the ground surface. Green magnetic tape with "storm drain" in red letters shall be laid 1-foot above the top of the service connection, wrapped around the cap at the end of the service, and brought to the surface wrapped around the 2-inch x 4-inch marker. Paint the top portion of the marker after its installation with first-quality green, quick drying enamel. After the paint has dried, use black, quick-drying enamel and neatly indicate the distance from the natural ground surface to the top of the service branch pipe in feet and inches.

Take precautions during the backfilling operation to ensure the position and location of the marker. If the marker is broken or knocked out of vertical alignment during the backfilling operation, reopen the trench and replace the marker.

401.03.06 Pipe Coupling Adapters

Use flexible mechanical compression joint coupling with No. 305 stainless steel bands manufactured by Joints, Inc., Fernco Joint Sealer, or approved equal.

401.03.07 Concrete Closure Collars

Only install concrete closure collars where specified in the Contract Documents. Construct concrete closure collars in conformance with the details provided. Wash pipe to remove all loose material and soil from the surface on which the concrete will be placed. Wet pipe thoroughly prior to placing the collars. Construct forms with materials that will ensure that no concrete shall enter the line. Make entire collar in one placement and do not place collars in water. Concrete closure collars shall be placed using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Do not backfill the trench until the concrete has sufficient strength.

401.03.08 Culverts

Remove and replace culverts in conformance to all applicable requirements of this section and *Section 206*.

401.03.09 Testing

401.03.09A General

When required by the Contract Documents or when the groundwater is too low to permit the visual inspection of leaks or when the quality of materials used or workmanship performed during the construction of storm drains is in doubt for any reason, the Engineer may require the storm drain and all applicable appurtenances to be tested. When so, the storm drain shall be required to pass the same tests as specified for wastewater sewers in *Subsection 301.03.12*.

Perform the tests in a manner satisfactory to the Engineer. Calibrate gauges for air testing with standardized test gauge provided by the Contractor at the start of each testing day. The Inspector shall also witness the calibration. Notify the Inspector at least 24-hours prior to each test.

All testing, including but not limited to deflection and air tests, if required, and TV inspections, must be passed before final lift of paving can be placed over the pipe.

The City shall make a televised (TV) inspection of the pipe after the Contractor has completed the installation of the pipe, including all backfill and including deflection and air tests if required, but before paving. When the Contractor has jetted and cleaned the pipe, the inspection shall be scheduled by the Contractor with the Inspector. Any defects in material or workmanship shall be satisfactorily corrected at no expense to the City. The Contractor shall re-TV the pipe after any corrections, in accordance with **Subsection 301.03.12D** and supply the TV video and the report to the Project Manager for review and approval. This process will repeat until the pipe complies with the specifications prior to paving.

The City may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of sections of storm drain and allow connections prior to the whole system being completed.

Water and Equipment for Test – Water and equipment for tests shall conform to the applicable portion of **Subsection 301.03.12A**.

Cleaning Prior to Testing and Acceptance – Cleaning shall conform to the applicable portion of **Subsection 301.03.12A**.

Repairs – Repair or replace in accordance with **Subsection 301.03.04**, and in a manner satisfactory to the Engineer, any section of pipe not meeting the air test requirements, deflection test requirements, joint testing requirements, alignment requirements, or which has leakage and/or infiltration. Re-rounding of the pipe will only be allowed if approved by the Engineer.

401.03.09B Deflection Test for Flexible Pipe (HDPE and PVC)

Deflection tests for flexible pipe shall be in accordance with **Subsection 301.03.12B**.

401.03.09C Air Testing

401.03.09C1 Standard Air Testing

Standard air testing shall be in accordance with **Subsection 301.03.12C1**.

401.03.09C2 Joint Air Testing for Storm Sewers with Pipe Diameters Greater than 35-Inches

Joint air testing for sewers with pipe diameters greater than 35-inches shall be in accordance with **Subsection 301.03.12C2**.

401.03.09D Television Inspection of Storm Drains

TV inspections of storm drains will be in accordance with **Subsection 301.03.12D**.

401.04 MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)

401.04.01 Storm Drain Pipe

Measurement and payment for storm drainpipe, including culverts and pipe stub-outs from manholes, will be made on a lineal foot basis for the various classes, types, and sizes of pipe listed in the Contract Documents and as actually installed. All pipe will be measured horizontally from center-to-center of manholes or to the ends of the pipe, whichever is applicable. No deductions will be made for fittings or for structures.

Payment shall constitute full compensation for the pipe in-place, including trench excavation, furnishing, placing and compacting pipe bedding, pipe zone material, and native backfill material, testing, and plugs.

401.04.02 *Concrete Closure Collars*

Measurement and payment for concrete closure collars will be made at the unit price each as shown in the Contract Documents and actually constructed. Payment shall include full compensation for all materials, equipment, and labor necessary to complete the work. If not listed in the Contract Documents, then they will be considered incidental to the other work.

401.04.03 *Field Fabricated Connections*

Measurement and payment for field-fabricated connections will be made at the unit price each for the type and size as shown in Contract Documents. Payment shall include full compensation for all materials, equipment, and labor necessary to complete the work. If not shown in the Contract Documents, then they will be incidental to the other work.

402 MANHOLES, INLETS, AND CONCRETE STRUCTURES

402.01 *DESCRIPTION*

This section covers the work necessary for the construction of the following items:

1. Manholes
2. Sumps
3. Inlets and catch basins
4. Anchor walls
5. Special concrete structures
6. Concrete encasement

402.02 *MATERIALS*

402.02.01 *Base Rock*

Base rock requirements shall be in accordance with *Subsection 302.02.01*.

402.02.02 *Forms*

Form requirements shall be in accordance with *Subsection 302.02.02*.

402.02.03 *Concrete and Reinforced Steel*

Concrete and reinforcing steel shall conform to *Section 205*.

402.02.04 *Cement Mortar*

Cement mortar requirements shall be in accordance with *Subsection 302.02.04*.

402.02.05 *Manholes*

402.02.05A *Standard Precast Manhole Sections*

Standard precast manhole sections shall conform to the requirements of *Subsection 302.02.05A*.

402.02.05B *Precast Concrete Bases*

Manholes, except when placed over existing storm drainpipes, shall be constructed using precast, reinforced concrete bases. Construction of precast bases shall conform to the requirements of ASTM C-478. The base riser section shall be integral with the base slab. The riser section shall extend a minimum of 8-inches above the crown of the largest mainline pipe entering the manhole, exclusive of drop storm drainpipes.

402.02.05C *Poured-in-place Manhole Bases*

The Contractor may use poured-in-place manhole bases only over existing storm drainpipes. Concrete shall conform to *Section 205*.

402.02.05D *Manhole Grade Rings*

Manhole grade rings shall conform to *Subsection 302.02.05D*.

402.02.05E *Jointing Materials*

Manhole jointing materials shall conform to *Subsection 205.02.09D*.

402.02.05F *Manhole Steps*

Manhole steps shall comply with *Subsection 302.02.05F*.

402.02.06 *Pipe and Fittings*

Conform to requirements of *Section 401*.

402.02.07 *Precast Inlets and Catch Basins*

Precast base and extension units shall conform to ASTM C-913 and shall be used in the construction of all inlets. Concrete risers for extensions shall be a minimum of 4-inches in height and shall be the same quality as the main section. All catch basins shall be poured-in-place. Precast catch basins are prohibited.

402.02.08 *Manhole Frames and Covers*

Manhole frames and cover requirements shall be in accordance with *Subsection 302.02.07*.

402.02.08A *Cap Screws*

Cap screws and washers for tamperproof and watertight manhole covers shall be stainless steel with 60,000psi minimum tensile strength conforming to ASTM A-453.

402.02.09 *Standard Frames and Grates for Inlets and Catch Basins*

Frames and grates for catch basins and storm drain inlets shall be fabricated of steel conforming to ASTM A-36 and A-373 in accordance with the Standard Details. All connections shall be welded. Welding shall conform to requirements of current code for welding in building construction of the American Welding Society. Frames and gratings shall be tested, one within the other, and there shall be no more than 1/16-inch rock.

When checked by a test jig, the bearing seat of either component shall have no more than 1/16-inch rock. Test jibs shall be furnished by the manufacturer.

402.02.10 *Sedimentation Manhole and Storm Sump Systems*

The precast sections shall comply with **Subsection 402.02.05**. The frame and cover shall comply with **Subsection 302.02.07** and shall be tamper-proof when the system is located in unpaved areas.

Drain Rock: Drain rock shall be 2-inches to 4-inches in size, clean, round, imported material. When 2-inch to 4-inch size is unavailable, drain rock shall be 2-inches in size, clean, round, imported material with each precast perforated sump section encased with Type III or IV polyethylene netting.

Polyethylene Netting: Netting shall be in accordance with ASTM D-1248. Netting shall meet the following specifications:

1. 1.5% carbon black
2. Tensile strength of 300 lbs./ft., per ASTM D-5034
3. 0.50-inch openings

402.03 *CONSTRUCTION*

402.03.01 *General*

402.03.01A *Excavation and Backfill*

Conform to applicable provisions in **Section 204**. Backfill around manholes, inlets, catch basins, and other appurtenances shall be of the same type as the trench backfill immediately adjacent.

402.03.01B *Base Rock*

Place crushed aggregate base rock and thoroughly compact with a mechanical vibrating or power tamper.

402.03.01C *Foundation Stabilization*

If material in bottom of excavation is unsuitable for supporting manholes and other stormwater appurtenances, excavate below subgrade as directed and backfill to required grade with rock conforming to Foundation Stabilization in **Subsection 206.03.07**.

402.03.02 *Manholes*

Manhole requirements shall conform to **Subsection 302.03.02**, except that manholes will only need to be vacuum tested as specified in **Subsection 402.03.06**.

402.03.03 *Pipe Stub-outs from Manholes*

Pipe stub-outs from manholes shall be installed in accordance with **Subsection 302.03.04**.

402.03.04 *Manhole Grade Rings*

Manhole grade rings shall be installed in accordance with **Subsection 302.03.05**.

402.03.05 *Manhole Frames and Covers*

Manhole frames and covers shall be installed in accordance with **Subsection 302.03.06**.

402.03.06 Vacuum Testing

When required by the Contract Documents, or when the groundwater is too low to permit visual detection of leaks, or when the quality of materials used or workmanship performed during the construction of stormwater facilities are in doubt for any reason, the Engineer may require the storm drain and all applicable appurtenances to be tested. When so ordered, the manholes shall be required to pass tests as specified in **Subsection 302.03.07**.

402.03.07 Concrete Encasement

Concrete encasement shall conform to requirements in **Subsection 302.03.08**.

402.03.08 Installation of Inlets and Catch Basins

Install inlets and catch basins at the locations shown on the plans and in accordance with **Subsection 4.12.02**.

Construct inlets and catch basins as shown on the Standard Details.

Set frames and grates at elevations shown or as directed. Frames shall be cast in concrete. Bearing surfaces shall be clean and provide uniform contact. Anchor bolts and other fastenings shall be firmly embedded in concrete.

Any surrounding structures (e.g., pavement, curbs, gutters, sidewalks, driveways) and landscaping damaged during installation of inlets or catch basins shall be restored in accordance with the Construction Standard Specifications at no expense to the City.

402.03.09 Inlet Extensions

Install extensions to height as required. Use the largest size (in height) pre-cast extension risers available from the manufacturer that will allow for conformance with the specified finished grade. Stacking small pre-cast extensions where a larger extension could be used is prohibited. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying an approved curing compound or other approved method. Extensions shall be watertight.

402.03.10 Cleaning

Upon completion, clean each structure of all silt, debris, construction-related sediment, and foreign matter.

402.03.11 Manhole Steps

Steps shall comply with requirements of **Subsection 302.03.10**.

402.03.12 Sedimentation Manhole and Storm Sump Systems

Precast sedimentation manhole and storm sump systems shall be constructed in conformance with the Standard Details. Maximum depth of storm sumps shall not exceed 30-feet as measured from the manhole rim and shall not be less than 20-feet unless approved by the Engineer.

Precast perforated sump sections encased with HDPE netting shall have the HDPE netting overlap a minimum of 1-foot. Netting shall be banded in 3 locations per manhole section with 3/4-inch steel bands. The first band shall be located above the weep hole openings; the second shall be located at mid-section; and the third shall be located below the weep hole openings.

402.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

402.04.01 Manholes

Measurement and payment for manholes will be made on a unit price basis for each type shown in the Contract Documents for manholes 6-feet deep, plus the unit price per foot shown in the Contract Documents for extra depth of manholes over 6-feet. No deduction will be made for depths less than 6-feet. Measurement of manhole depth will be from the top of the manhole frame and cover to the manhole invert at the center of the manhole to the nearest 1/10-foot. Payment shall include full compensation for all materials, labor, steps, and equipment required to construct manhole in-place.

402.04.02 Tamperproof and Watertight Manhole Frames and Covers

Measurement and payment for tamperproof manhole frame and covers shall be considered as incidental to the construction of manholes and no separate payment shall be made.

402.04.03 Concrete Encasement

Measurement and payment for concrete encasement will be made on a lineal foot basis as shown in the Contract Documents for the size pipe to be encased. Length shall be measured along the centerline of the pipe. Payment shall include full compensation for all materials, equipment, and labor required to construct the work complete in-place.

402.04.04 Catch Basins and Inlets

Measurement and payment for catch basins and inlets will be made on a unit price basis, per each catch basin or inlet, for the number and type actually constructed. Payment shall include full compensation for all materials, equipment, and labor required to construct the work complete in-place, including the replacement of any surrounding structures damaged during construction.

402.04.05 Sedimentation Manhole and Storm Sump Systems

Measurement and payment for precast sedimentation manhole and storm sump systems will be made on a unit price basis per each system constructed. Payment shall include full compensation for all materials, equipment, and labor required to construct the work complete in-place, including the replacement of any surrounding structures damaged during construction.

402.04.06 Other Items

Measurement and payment for other items not specified above shall be made at either the unit price or lump sum basis for each bid item as shown in the Contract Documents, or shall be incidental for work not listed in the Contract Documents. Payment shall be full compensation for all materials, equipment, and labor necessary to complete the work.

403 WORK ON EXISTING STORM DRAINAGE STRUCTURES

403.01 DESCRIPTION

This section covers the work necessary to join new work to existing, the abandoning of storm drains and structures, and adjusting existing utility structures to finished grades, and shall included the requirements of **Sections 401 and 402** unless otherwise modified herein.

403.02 MATERIALS

Conform to requirements of *Section 205* and to the requirements for related work referred to herein.

403.03 CONSTRUCTION

403.03.01 Excavation and Backfill

Conform to requirements of *Section 206*.

403.03.02 Manholes Over Existing Storm Drains

Manholes over existing storm drains shall conform to the requirements of *Subsection 303.03.02*, except that manholes will only need to be vacuum tested as specified in *Subsection 402.03.06*.

403.03.03 Connection to Existing Manholes, Inlets, and Concrete Structures

Provide all diversion facilities and perform all work necessary to maintain flow in existing lines during connection. Breakout existing base or sawcut opening in wall with concrete saw. Grout in new pipe to provide watertight seal and, when applicable, smooth flow into and through existing manhole as specified in *Subsection 403.03.09*.

403.03.04 Removal of Existing Pipes, Manholes, and Appurtenances

Removal of existing pipes, manholes, and appurtenances shall conform to the requirements of *Subsection 303.03.04*. Filling, removing, and/or abandoning of storm sumps shall be per approved DEQ procedures and permits.

403.03.05 Filling Abandoned Manholes, Inlets, Catch Basins, and Storm Sumps

Filling abandoned manholes, inlets, and catch basins shall conform to the requirements of *Subsection 303.03.05*.

403.03.06 Existing Manhole Frames and Covers

Requirements for existing manhole frames and covers shall be according to *Subsection 303.03.06*.

403.03.07 Permanent Plugs

Requirements for permanent plugs shall be according to *Subsection 303.03.07*.

403.03.08 Adjusting Existing Structures to Grade

Existing manholes, inlets, catch basins, and similar structures shall be brought to the specified finished grade by methods of construction as required in *Section 610*.

403.03.09 Reconstruct Manhole Base

Reconstruct manhole bases in accordance with requirements of *Subsection 303.03.09*.

403.03.10 Connect Pipe to Existing Inlets

Connect pipes to existing inlets in accordance with requirements of *Subsection 303.03.10*.

403.03.11 Storm Sump Protection

When a storm sump is encountered, the Contractor will take all precautions to protect the structure and replace all disturbed structures and materials to their original condition.

403.03.12 *Sedimentation Manhole and Storm Sump System Retrofits*

Conform to applicable requirements of *Sections 302, 206, and 205*. Precast sedimentation manhole and storm sump systems shall be constructed in conformance with the Standard Details, and applicable requirements for Sedimentation Manhole and Storm Sump Systems of *Sections 402 and 403* herein.

403.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

403.04.01 *Manholes Over Existing Storm Drains*

Measurement and payment for manholes over existing storm drains will be made at the unit price for each. Payment will include compensation for excavation and backfill, constructing manhole over existing line, final adjustment to grade, maintaining flow, and forming new flow channel.

403.04.02 *Removal of Existing Pipes, Manholes, and Appurtenances*

Payment for removal and disposal of existing pipes, manholes, and appurtenances will be considered as incidental to the work and included in the bid item for excavation and backfill as specified in *Section 204*.

403.04.03 *Connection to Existing Manholes*

Measurement and payment for connection to existing manholes will be made on a unit price each basis. If no bid item is included in the Contract Documents for “connection to existing manholes”, all costs will be considered incidental work for which no separate payment will be made.

403.04.04 *Filling Abandoned Manholes, Inlets, Catch Basins, and Storm Sumps*

Measurement and payment for filling abandoned manholes will be made on a unit price each basis.

403.04.05 *Adjusting Existing Structures to Grade*

Measurement and payment for adjusting existing manholes, catch basins, inlets, and similar structures will be made on a unit-price-each basis for the type shown in the Contract Documents. If no item is included in the Contract Documents for “adjust existing structures to grade”, all costs will be considered incidental work for which no separate payment will be made.

403.04.06 *Reconstruct Manhole Base*

Measurement and payment for reconstructing manhole base will be made on a unit-price-each basis. If no item is included in the Contract Documents for “reconstruct manhole base”, all costs will be considered incidental work for which no separate payment will be made.

403.04.07 *Connect Pipe to Existing Catch Basin*

Measurement and payment for connecting new pipe to existing catch basins will be made on a unit-price-each basis.

403.04.08 *Storm Sump Protection*

Measurement and payment for storm sump protection will be made on a unit-price-each basis if shown in the Contract Documents. Compensation will be for all materials, labor, and equipment necessary to bring the structure equal to its original undisturbed condition.

If no item is included in the Contract Documents for “storm sump protection”, all costs will be considered incidental work for which no separate payment will be made.

403.04.09 *Sedimentation Manhole and Storm Sump System Retrofits*

Measurement and payment for retrofit of sedimentation manhole and storm sump systems will be made on a unit price basis per each line item in the Contract Documents. Payment shall include full compensation for all materials, equipment, and labor required to construct the work complete and in-place, including the replacement of any surrounding structures damaged during construction.

403.04.10 *Other Items*

Measurement and payment for other items not specified above shall be made at either the unit-price or lump-sum basis for each bid item as shown in the Contract Documents, or shall be incidental for work not listed in the Contract Documents. Payment shall be full compensation for all materials, equipment, and labor necessary to complete the work.

****END OF DIVISION****

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501 GENERAL

The following specifications, in conjunction with applicable requirements of other parts of the Contract Documents, the Plans, and Addenda, shall govern the character and quality of material, equipment, and construction procedures for water work. All work done shall be in compliance with the requirements and restraints of OSHA, the State of Oregon Accident Prevention Division regulations, and the Workers' Compensation Board. In addition, all work shall be completed in conformance with State of Oregon, Multnomah County, and/or City of Gresham street opening permits.

502 WATER WORKS MATERIALS

502.01 CAST IRON AND DUCTILE IRON FITTINGS

All fittings shall conform to ANSI/AWWA Specification C110/A21.10 or ANSI/AWWA Specification C153/A21.53. All cast iron fittings and flanged ductile iron fittings shall be Class 250 and all ductile iron mechanical joint fittings shall be Class 350. Fittings shall be furnished with flanged or mechanical joints as specified on the plans. Fittings shall be furnished with a standard outside coating and a cement mortar lining with bituminous seal coat conforming to ANSI/AWWA Specification C104/A21.4. Fittings shall be factory lined with cement mortar or cement lined to factory standards. No field coating with cement will be approved other than for minor repairs as approved by the Engineer. Fittings shall be new and free of defects in coating, body, and lining. During installation, fittings shall be properly aligned and bolted securely to provide watertight joints. All buried nuts and bolts shall receive a protective coating of an approved spray-on, auto-body asphalt undercoating. Protective coating shall be dried and cured before fitting is placed and covered. If coating is not dry, 2 layers of 8-mil plastic shall be wrapped around fitting and coated areas.

Fittings shall be manufactured by Griffin, Tyler, Union Foundry, U.S. Pipe, or approved equal.

502.02 MECHANICAL JOINTS

Mechanical joints, in addition to accessory glands, gaskets, and bolts, shall conform to the requirements of ANSI/AWWA C111/A21.11, except where specifically modified in AWWA C153 for compact ductile iron fittings. As stated in AWWA C111, T-bolts shall be made of either ductile iron, or "cor-ten" type, or approved equal. Bolts shall be marked to identify material and producer. Contractor shall provide the Project Manager with the bolt manufacturer's specifications that shall give the following information: manufacturer's name, type of material, and identifying mark. Follower glands for mechanical joints (including MJ shoe assembly on fire hydrants) shall be domestic made only, or as approved by the Engineer.

Mechanical joint gaskets shall be made of vulcanized synthetic rubber and shall be manufactured no earlier than the year prior to installation.

The recommended installation procedures in AWWA Specification C111, Appendix A, "Notes on Installation of Mechanical Joints", including bolt torque ranges, shall be followed.

502.02.01 Restrained Mechanical Joint Fittings

Retainer glands on mechanical joints are allowed on fire hydrant assembly installations and, where approved by the Engineer, on a case-by-case basis. Retainer glands shall be "Megalug" brand as manufactured by EBBA Iron Sales, Inc., or Roma grip as manufactured by Romac Industries, Inc. Restrained mechanical joints shall be used on ductile iron pipe and fittings only.

502.03 TAPPING SLEEVE AND VALVE

Tapping sleeve shall be JCM Model No. 432 or Mueller Model No. H-304 furnished with Class 125 ANSI B16.1 stainless steel outlet flange. Valve shall be mechanical joint by flange Mueller resilient wedge tapping gate Valve No. A-23 60-16 or approved equal.

502.04 FLANGED JOINTS

Flanges shall conform to ANSI Specification B16.1 for Class 125 flanges and shall conform in all other respects to ANSI/AWWA C110/A21.11. Bolts for assembly of flanged joints shall be of the size and quantity shown in the latest version of AWWA C110. As stated in AWWA C110, bolts shall conform to ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, Including Hex Cap Screws and Lag Screws. Nuts shall conform to ANSI B18.2.2, Square and Hex Nuts. Threads shall conform to ANSI B1.1 Standard for Unified Inch Screw Threads (UN and UNR Thread Form), Class 2A external and Class 2B internal.

Bolts and nuts shall be of low-carbon steel conforming to the requirements of ASTM A-307 Standard Specifications for Carbon Steel Bolts and Studs, 60,000psi Tensile Strength Grade B.

Contractor shall provide the Project Manager with the manufacturer's specifications regarding the bolts to be used on the project.

Flange gaskets shall be ring-type or full-face, 1/8-inch thick, red rubber as specified.

502.05 FLANGED PIPE OR SPOOLS

Flanged pipe or spools shall conform to the latest edition of ANSI/ANWA C115/A21.15. Flanges shall conform to requirements as specified in **Subsection 502.04** "Flanged Joints". Pipe used shall be Class 53 Ductile Iron. Pipe shall be furnished with coatings as specified in "Ductile Iron Pipe". Threads on the flanges and pipe barrel shall be taper pipe threads (NPT) in accordance with ANSI B1.20.1.

When ordering, the following minimum information shall be provided to the manufacturer: pipe size and finished length (flange to flange; flange to plain end).

Manufacturer shall provide the following information: length and weight shown on each pipe, flange manufacturer marking, country where cast, and ductile iron or cast iron stamped on flanges. If fabricator is other than flange manufacturer, fabricator's mark shall be stamped with metal die on each flange after assembly. Also, manufacturer shall provide statement that the flange pipe complies with the specified standards.

502.06 PUSH-ON DUCTILE IRON PIPE

Ductile iron pipe shall be Class 52. Physical properties shall not be less than 60-42-10 iron and pipe shall conform to the latest revision of ANSI/AWWA Specification C151/A21.51. Ductile iron pipe shall be factory lined with cement mortar and bituminous seal coat and coated outside with asphaltic seal coat. Push-on rubber gasket joints shall be U.S. Tyton joint pipe as manufactured by United States Pipe and Foundry, or Pacific States Cast Iron Company, or approved equal. Push-on and mechanical pipe joints shall conform to ANSI/AWWA Specification C111/A21.11 and flanged joints shall conform to ANSI/AWWA C115/A21.15.

502.06.01 RESTRAINED JOINT PIPE

Where called out and as shown on the plans, pipe shall be restrained using the "1100HD Harness" as manufactured by EBAA Iron Sales, Inc.; "MJ/TJ" or "Thrust-Lock" joint with "Megalug" retainer glands as manufactured by the Pacific States Cast Iron Company; "TR FLEX" joint pipe or "FIELD LOK" type gaskets as manufactured by the United States Pipe and Foundry Company; or approved equal.

502.07 *POLYVINYL CHLORIDE (PVC) WATERLINE PIPE AND TRACER WIRE*

PVC pipe shall only be used where approved by the Engineer. PVC pipe shall conform to AWWA C900 or C905 Standards as applicable and to Uni-Bell . All PVC pipe shall have a dimension ratio no greater than 18, with an outside diameter identical to cast iron. Sand shall be used in pipe zone around PVC. Tracer wire shall be a minimum 12-gauge coated copper wire with blue colored insulating coating. Splicing of tracer wire shall be done using 3M, Eton, or approved equal splice kit.

502.08 *POLYETHYLENE ENCASEMENT*

Polyethylene film shall conform to ASTM Standard Specification D-1248-78 and AWWA C105, having a minimum thickness of 0.008-inch (8 mil). Only polyethylene tubing, not sheets, shall be installed.

Polyethylene tubing shall be held in place with 2-inch wide adhesive tape that is compatible with polyethylene, with plastic binder twine, with nylon tie straps, or other method approved by the Engineer.

502.09 *VALVES (General)*

Direct-buried line valves of 12-inch size and larger shall be butterfly valves. All smaller, direct-buried line valves shall be gate valves. All valves shall be designed to AWWA specifications and shall have standard 2-inch-square operating nut unless otherwise shown on the plans. All valves shall open counter clockwise.

502.10 *GATE VALVES*

Gate valves 2-inches through 10-inches shall be resilient-wedge, non-rising stem with “O” ring packing, complying with AWWA C509 or C515-99. The valves shall be designed to withstand water-working pressures of 200psi or more. All valves shall be furnished with a 2-inch-square operating nut and shall open counter clockwise when viewing valve from above. Valves shall be coated inside and out with epoxy coating complying with AWWA C550.

Operation of the valve shall permit full withdrawal of the disc from the waterway to provide a clear, unrestricted passage when the valve is in the open position. The valve shall be furnished with joint ends as specified on the plans. Where flanges are furnished on valves, they shall conform to ANSI Specification B-16-1, Class 125.

Specified gate valves shall be Mueller, U.S. Pipe, Clow, M & H/Kennedy, American Flow Control, or approved equal.

502.11 *BUTTERFLY VALVES*

All butterfly valves shall be resilient, rubber-seat type conforming to AWWA C504 Class 150B and bubble-tight at 150psi pressure with flow in either direction. They shall be designed for direct burial and be satisfactory for application involving valve operation after long periods of inactivity. All valves shall be Mueller, U.S. Pipe, Clow, Pratt, M & H, Kennedy, American Flow Control, or approved equal. Operating nut for the valve shall be located on the side of the main shown on the plans.

502.12 *FIRE HYDRANT ASSEMBLY*

Fire hydrants shall conform to AWWA Specification C-502. The hydrants shall have a 5¼-inch minimum valve opening with a 6-inch mechanical joint inlet, a 6-inch mechanical joint by flanged resilient wedge auxiliary gate valve, two 2½-inch hose nozzles, 1 to 4½-inch pumper nozzle, a 1½-inch pentagon operating nut (opening counter clockwise) and a safety flange. The hydrant color shall be yellow (Sherwin Williams, GCC-5006) or approved equal. The fire hydrant shall be arranged for a maximum of a 6-foot bury. See Standard Detail 501 for additional requirements.

The auxiliary valve shall be as described in 502.10 Gate Valves and be furnished complete with “Vancouver” valve box and accessories.

Fire hydrant shall be Mueller Super Centurion 250 No. A-423 only.

Fire hydrant shall have been manufactured no earlier than the year prior to installation.

502.13 CAST IRON VALVE BOXES

Valve boxes shall be the cast iron "Vancouver" pattern (18-inches tall casting only) or "Portland" pattern. Valve riser pipe from the valve to the cast iron top shall be 6-inch PVC sewer pipe ASTM D-3034, SDR35 for the Vancouver box, or 8-inch PVC sewer pipe ASTM D-3034, SDR35 for the Portland box. See Standard Details 513 and 514. "Vancouver" pattern valve boxes shall be used for all valves and 2-inch blow-off standpipes. "Portland" pattern shall only be used for 4-inch and 6-inch blow-off standpipes and for cathodic protection test stations.

Valve box castings shall be smooth and uniform. Box lid shall not protrude above the rim and lids shall seat flat without rocking. Boxes of uneven thickness, pitted, or otherwise flawed in the casting will be rejected. PVC sewer pipe shall be cut off smooth with no sharp edges, and shall be one continuous piece from valve to valve box assembly.

502.14 BLOW-OFF UNITS

502.14.01 2-inch

2-inch blow-off units shall consist of cast iron or ductile iron MJ cap, brass nipple, RW gate valve, mechanical restraint assemblies, galvanized pipe and fittings, and standard valve box assemblies. See Standard Detail 507A.

502.14.02 4-inch and 6-inch

4-inch and 6-inch blow-off units shall consist of a reducer, companion flange, RW gate valve, galvanized pipe and fittings, mechanical restraint assemblies, and valve box assemblies. See Standard Detail 507B.

502.15 COMBINATION AIR VALVE UNIT

Combination air valve unit shall consist of a 2-inch double-strap service saddle, 2-inch corporation stop (M.I.P. x M.I.P.), 2-inch brass ¼ bend (various end configurations), 2-inch R.W. gate valve (F.I.P. x F.I.P.), 2-inch brass nipples, 2-inch brass coupling (M.I.P. x Flare or Mueller 110 Compression), 2-inch ASTM B-88 rigid copper, 2-inch Val-matic #202C or APCO #145C-2 combination air valve unit, 2-inch unions (Flare or Mueller 110 Compression), 48-inch concrete manhole cone, Valley Iron and Steel Frame #106, 108 or approved equal, cover #105, 107 or approved equal, 12-inch concrete blocks, "Hot Box" EZ Box #EZ.75, or approved equal and all other items as noted on Standard Detail 506.

502.16 2-INCH SERVICE SADDLES

Service saddles shall be 2-inch F.I.P.T., double strap. Service saddles shall be Romac Industries style, or approved equal. Body of saddle and nuts shall be ductile iron ASTM A-536 Grade 05-45-12, and straps shall be stainless steel 202N ASTM A-194.

502.17 COPPER PIPE

1-inch service lines shall be soft temper Type K, copper water tube, meeting ASTM B-88 Specifications. 2-inch service lines shall be (hard) drawn temper, Type K, meeting ASTM B-88 Specifications.

502.18 BRASS FITTINGS

502.18.01 Corporation Stops

1-inch corporation stops shall be Mueller B-25008 (110 Compression) or A.Y. McDonald 4701BQ or equal. 2-inch corporation stop for combination air valve unit shall be Mueller B-2969, or A.Y. McDonald 3131B, or approved equal with Mueller ¼ bend coupling H-15533 (F.I.P. x Mueller 110 compression), or approved equal.

502.18.02 *Angle Meter Stops*

1-inch Angle meter stops shall be Mueller B-4602BQ 24258 (110 Compression). 2-inch shall be Mueller, H-14277 (110 Compression).

502.18.03 *Meter Yoke (Setter)*

2-inch meter yoke (setter) shall be Mueller B-2423-99000, or approved equal.

502.18.04 *Copper Unions*

Three-part copper-to-copper union shall be Mueller H-15403 (110 Compression), or approved equal.

502.18.05 *Copper Couplings*

Straight couplings, copper to inside iron pipe thread, shall be Mueller H-15451 (110 Compression x F.I.P.), or approved equal. Straight couplings, copper to outside iron pipe threads, shall be Mueller H-15428 (110 CTS, or approved equal).

502.19 *WATER QUALITY SAMPLING STATIONS*

Water quality sampling station shall consist of a ¾-inch corporation stop Mueller H-15008 (110 Compression), ¾-inch Type K soft temper copper tubing, ¾-inch 3 M.I.P. x (110 Compression) quarter bend coupling Mueller H-15531 (110 Compression), ¾-inch FIP ball valve, Mueller B-25209 (110 Compression), Eclipse No. 88 Sampling Station (Kupferle Foundry) or approved equal, standard "Vancouver" valve box assembly, ¾"-0" crushed rock backfill, and surface restoration as required. See Standard Detail 505. See Standard Detail 513 for valve box detail.

502.20 *CORROSION CONTROL MATERIALS*

502.20.01 *General*

Furnish catalog data for all corrosion control materials and obtain approval before ordering.

502.20.02 *Exothermic Welds*

Furnish molds, cartridges, and all required materials for exothermic (copper) welding as produced by "Cadweld", Erico Products, Inc., or approved equal. Provide molds and cartridges as recommended in writing by the manufacturer. Use "Cadweld" F-33 alloy or approved equal for connections to steel pipe. For connections to ductile iron pipe, "Cadweld" F-33 alloy or approved equal may be used if field-testing indicates that it works adequately. Otherwise, use "Cadweld" XF-19 alloy or approved equal. Welder molds shall be graphite; ceramic molds are not acceptable.

502.20.03 *Gray Pad*

Furnish gray pad as manufactured by Tapecoat or approved equal for protection of exothermic weld. Pads shall meet AWWA Standard C209. Pads shall have a minimum thickness of 55-mils.

Furnish liquid primer to be applied to the pipe surface as supplied by the manufacturer.

502.20.04 *Test Station Materials*

Refer to Standard Details 521 through 525.

Flush-mounted test station shall be a “Portland” cast iron valve box complete with a terminal board suited to the application.

Post-mounted test station shall be a rigid pipe design with a terminal board suited to the application. Test station shall be of molded Makrolon polycarbonate, mounted on white ultra-violet stabilized polyethylene conduit pre-drilled with anchor and access holes for wires. Conduit shall be supplied in standard 6-foot length with anchor. Hardware (machine screws, washers, hex-nuts) shall be marine brass nickel-plated. Each test station shall consist of a lockable cover, a terminal board with integral compression fit base, a compression nut for clamping the base to the conduit, and complete hardware. Test station shall be yellow-colored and 3-inch diameter conduit size unless otherwise indicated on the plans, with a 5-lead or 8-lead terminal board as required. Test station shall be Big Fink by Cott Manufacturing Company, or approved equal.

502.20.05 *Wire*

Wire for test stations and galvanic anodes shall be single-conductor, stranded copper with 600-volt type TW or THWN insulation. Wire for joint bonds shall be single-conductor, stranded copper with 600-volt type HMWPE insulation. Provide the wire size shown on the plans, Standard Details, or as specified by the Engineer.

502.20.06 *Reference Electrodes*

Reference electrodes shall be 1.4-inches by 1.4-inches by 9-inches long, cast of special high-grade zinc as specified in ASTM B 6-77. Reference electrodes shall be supplied prepackaged in a permeable cloth bag with 75% gypsum, 20% bentonite, and 5% sodium sulfate backfill. Lead wire shall be unspliced and sized by the manufacturer for the specific site, but a minimum of 25-feet long of No. 12 AWG stranded copper wire with yellow 600-volt Type THWN insulation. The lead wire shall be attached to the electrode core with the manufacturer’s standard connection. The connection shall be stronger than the wire.

502.20.07 *Galvanic Anodes*

Supply galvanic anodes of the quantity, composition, dimensions, metal weight, and packaged backfill specified by the Engineer of Record. Unless specified otherwise, zinc anodes shall meet the requirements of ASTM B418-73 Type II, and magnesium anodes shall meet the requirements of ASTM AZ 63A Type II or High Potential Magnesium Alloy Galvomag Dow Patent No. 2805198. The anodes shall be prepackaged in a permeable cloth bag containing the manufacturer’s prescribed backfill and the packaged anode shall be a minimum of 2.5-times the bare anode weight. The anode lead wire shall be connected by the manufacturer and it shall be of an unspliced length specific to the application but not less than 10-feet.

502.20.08 *Dielectric Insulating Connections, Insulating Flanges, Flexible Sleeve Couplings, Casings, and Wall Penetration Sleeves*

For dielectric, furnish AWWA insulating flange connection as shown on Standard Detail 526; for straight pipe connections, use PVC water pipe as specified in **Subsection 502.07** with solid sleeve, MJ, long pattern. PVC pipe shall only be used in corrosion control areas.

502.20.09 *Conduit*

Rigid PVC conduit shall be Schedule 40 UL listed for direct burial, concrete encasement and exposed. Approved manufacturers are Carlon, Western Plastics, or approved equal. Openings into conduit shall be smooth and rounded to prevent damage to wire insulation. Changes in direction shall be made with manufactured 2-foot-radius minimum sweeps.

502.20.10 *Wire Splice Kits*

- A. Wire connectors shall be compression type suitably sized for wire size.
- B. For wire splices the connectors shall be butt style HyLink Type YSV, or approved equal.
- C. For test lead-ends they shall be HyLug Type TAV, or approved equal.

Where Engineer orders wires to be spliced and extended, the following materials, or approved equal, shall be used: for #8 AWG wire, splice with Burndy No. KS-20 split bolt connector and 3M Scotch cast resin-splicing kit No. 90-B1; for #12 AWG wire, splice with 3M DBY Direct Bury splice kit.

502.21 WATERLINE MARKERS

Plastic waterline markers shall be 6-feet long, blue plastic, Carsonite Model CUM-375 with label No. CW-112 or approved equal. Markers for paved easement areas shall be brass surveyor's monument caps inscribed with the words, "CAUTION: BURIED PUBLIC WATERLINE. CALL FOR LOCATES BEFORE DIGGING."

502.22 TRACER WIRE

Copper tracer wire for locating mains shall be 12-gauge stranded copper with blue plastic insulation. Where allowed by Engineer, splicing of tracer wire shall be done using 3M, Etcon, or approved equal waterproof splice kit suitable for direct bury.

503 CONSTRUCTION

503.01 STORAGE OF EQUIPMENT AND MATERIALS

Unless otherwise noted on the plans or in the Contract Documents, it shall be the responsibility of the Contractor to locate an approved storage site for all equipment and materials.

Prior approval shall be obtained from the governing agency for any storage of equipment or materials within the right-of-way (e.g., stringing of pipe).

Pipe, fittings, and valves shall be stored in such a way as to minimize contamination or damage prior to installation.

503.02 PLACING AND BLOCKING PIPE AND FITTINGS

The pipe shall be laid true to line, without objectionable breaks in grade, and shall be firmly bedded with 6-inches of ¾"-0" crushed rock for the entire length of the pipe.

Where conflicts arise between the designed grade of the waterline and an existing underground structure, the depth of the trench may be increased to permit proper installation of the waterline

Care shall be taken to clean joints and to keep them free of water during construction. Whenever water is excluded from the interior of the pipe, adequate backfill shall be deposited on the pipe to prevent floating. In the event of any flotation occurring, the pipe so affected shall be removed from the trench, replaced, and re-laid at the Contractor's sole expense.

Each section of the pipe and each fitting and valve shall be clean before it is lowered into the trench. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, or blowing out with compressed air, or washing to remove all foreign matter. The most adequate method of cleaning out pipe and fittings will be determined on the job by the Inspector.

If clean pipe sections and fittings cannot be placed in the trench without getting dirt into the open ends, the Inspector may require that a piece of tightly woven canvas be tied over the ends of the pipe or fitting until it has been lowered into position in the trench. After the pipe or fitting has been lowered into the trench, all foreign matter shall be completely brushed from the bell and spigot ends before assembly. At the end of each day or during suspension of the work, the pipe ends shall be securely closed by means of a secure plug or approved equivalent. Water in the trench shall not be allowed to enter the pipe and fittings.

All tees, elbows, and any major changes in direction of pipe alignment shall be securely blocked using appropriate size thrust block based on the size and pressure of the water main to be constructed, or be mechanically restrained as identified on the plans. All pipe and fittings in contact with concrete shall be completely wrapped in 2-layers of 8-mil plastic prior to the placement of the concrete. Concrete used for thrust and straddle blocking shall have a slump of 2-inches to 4-inches and a minimum 28-day strength of 3300psi. Concrete mix shall be uniformly blended with appropriate quantity of water before being placed in the trench and shall not contain any dirt or other foreign matter. Thrust blocks shall be formed so that fitting joints and bolts remain accessible. Blocks that are to be removed in future waterline extensions shall be supplied with a rebar-pulling loop and formed so that the block may be pulled off without disturbing the fitting (See Standard Details 508, 509, and 510). Water pressure shall not be applied to the waterline for a minimum of 48-hours after placement of thrust and straddle blocks. All concrete shall be subject to sampling and testing as directed by the Engineer.

If it is necessary to cut the pipe to lay it on curves or to cause a change in direction, the Contractor shall cut the pipe as required for proper installation. A maximum of 3° deflection is allowed at bell joints. Where the cut length of pipe is to be installed into the bell end of another pipe, the cut end shall be beveled to ensure a proper seal. To set valves and fittings properly, the pipe shall be cut to the exact length required to obtain the designated locations.

In all areas where PVC pipe is installed, 12-gauge copper tracer wire shall be installed. Tracer wire shall be laid on top of the waterline, or as directed by the Engineer. Wire shall be continuously conductive. Wire shall be insulation-coated and brought to the surface at locations shown on the plans. Where wire is brought into meter box, 1-foot of wire shall be left in box with the last 1-inch of wire left uncoated. Where wire is brought into a valve box, a ¼-inch galvanized bolt and nut shall be installed in a ¾-inch hole drilled in the valve box. The tracer wire shall be looped twice around the bolt and the last 1-inch of copper shall be left uncoated. Splicing of wire shall be done using 3M Etcon or approved equal splice kit. See Standard Detail 517.

Pipelines crossing a sanitary sewer line shall be treated as outlined on Standard Detail 511 and as directed in the field by the Inspector and according to Oregon Department of Human Services, Health Services rules (Oregon Administrative Rules Chapter 333).

All dead end lines require a standard 2-inch, 4-inch or 6-inch blow-off assembly. This will allow for flushing and release of line pressure during future waterline extension.

503.03 WET TAPPING EXISTING MAIN

When specified, a wet tap on existing water main shall be made to minimize interruption of service to customers. Tapping sleeve and valve shall conform to **Subsection 502.03**.

Before attaching tapping sleeve, care shall be taken to clean water main of all debris and defects. Attach sleeve and valve to the main. Then attach proper tapping machine to valve. Pressure test this assembly before making tap. After making tap, remove the tapping machine and inspect fitting and valve for leaks. If any such leaks are found, Contractor shall be required to repair the defect. Attach branch main to valve and install pipe in accordance with **Subsection 503.02**. Taps shall be made no closer than 18-inches from end of sleeve to nearest joint, tap, or fitting. Maximum allowable tap shall be 10-inches, unless authorized by the Engineer.

Excavation for tap shall be such as to fully expose main with a minimum depth below main of 12-inches. A minimum of 18-inches of main shall be exposed from the end of the tapping sleeve. Also, excavate enough area to accommodate tapping machine and workers.

503.04 POLYETHYLENE ENCASEMENT OF PIPE AND FITTINGS

When specified, install polyethylene encasement, tube type, on all pipe and appurtenances. Polyethylene film shall conform to ASTM Standard Specification D-1248-78, having a minimum thickness of 0.008-inch (8-mil). Install this encasement in accordance with AWWA C105 Method A, one length of polyethylene tube for each length of pipe. The use of polyethylene sheets will not be allowed. Sand backfill shall be placed within the pipe zone and bedding area wherever polyethylene encasement is used.

Cut tubing open if necessary to wrap valves and fittings. Valves shall be wrapped up to the bottom of the operating nut. Polyethylene shall be wrapped snugly around the pipe and held in place by using an adhesive tape compatible with polyethylene, plastic binder twine, or nylon tie straps. Backfill material shall not be allowed to get under the polyethylene and pockets in the polyethylene that can trap backfill material shall be eliminated.

Where crossing a cathodically protected utility, a geomembrane or PVC casing may be required around waterline. See Standard Details 418 and 419 for installation and material requirements.

503.05 PLACING VALVE UNITS

A valve unit shall consist of a valve, bolts, gaskets, followers, PVC riser pipe, and "Vancouver" style cast iron valve box and lid.

Valves shall be placed in a vertical position at locations shown on the plans. The Contractor shall check each valve to determine that the valve is properly adjusted to seat securely and open fully. Valves not meeting these requirements shall not be installed. Valve boxes and PVC riser pipe shall be placed in a vertical position centered over the valve operating nut and the backfill shall be carefully compacted around the box. Any valve boxes found off center from the valve-operating nut shall be removed and replaced into the proper position. The top of the valve box shall be adjusted to meet finish grade. PVC riser pipe shall extend up inside the valve box a minimum of 5-inches to allow future rising of the box. Notches shall be cut into the rim of the valve box as detailed on Standard Detail 513. Valve boxes shall be placed so that the notches line up parallel with the water main below. A 12-inch-square x 3-inch-thick pad of 3,000psi concrete shall be placed around the top of all valve boxes not in a paved area.

The Contractor shall not operate any valve touching potable water unless authorized by the Engineer.

503.06 PLACING FIRE HYDRANT ASSEMBLIES

The fire hydrant assembly shall consist of a Mueller Super Centurion 250 MDL A-423 mechanical joint hydrant, approved resilient wedge mechanical joint by flange auxiliary gate valve, "Vancouver" style valve box, accessories, concrete block, drain rock, and "Megalug" retainer glands, or approved equal.

The fire hydrant shall be placed in a vertical plumb position on a precast 6-inch-thick concrete block having a bearing surface of not less than 1.75 square feet. The hydrant shall be securely restrained using "Megalug", "Romagrip", or approved equal retainer glands. A minimum of 10-feet of mainline each side of hydrant tee and all pipe and fittings between tee valve and hydrant shoe shall be restrained. No pipe joints shall exist between auxiliary valve and fire hydrant, unless the distance is greater than 18-feet. If distance from valve to fire hydrant is greater than 18-feet, a "field-lok" type gasket or approved equal shall be used in the bell joint. Hydrant drain holes shall not be blocked. Not less than 4 cubic feet of clean 1½-inch to ¾-inch round drain rock shall be placed around the base of the hydrant for drainage. Regardless of condition, the fire hydrant shall be spray painted with Sherwin Williams GCC 5006 (yellow) or approved equal upon completion of installation. Where no sidewalk exists around hydrant bury, a 5-foot x 5-foot x 4-inch concrete pad shall be placed around hydrant. In cases where concrete is placed around hydrant, bury shall have expansion joint material in accordance with **Subsection 607.03.07** placed around the bury. See Standard Detail 501.

Bury line of fire hydrant shall not be below finished grade. Bury line of hydrant shall be a maximum of 2-inches above finished grade. Pumper port of fire hydrant shall be perpendicular to curb.

All fire hydrants shall be arranged with a maximum of a 6-foot bury. Where the depth of the water main serving the fire hydrant is deeper than would allow a 6-foot bury to be installed, vertical bends shall be used in the 6-inch fire hydrant lead pipe to allow for a 6-foot or less bury.

Fire hydrant extension kits are not allowed, unless authorized by the Engineer. A City Water Operations person shall be present at any extension kit installation procedure.

Guard posts, a minimum of 3-feet high, shall be required for protection from vehicles when necessary. Such protection shall consist of 4-inch diameter steel pipes 6-feet long, filled with concrete, and buried a minimum of 3-feet deep in concrete, and located at the corners of a 6-foot square with the hydrant located in the center. Posts shall be painted with the same paint as the fire hydrant. Use of posts other than at the 4 corners may be approved by the Engineer.

503.07 COPPER SERVICE INSTALLATION

Where indicated on the drawings or as determined in the field by the City, the Contractor will be required to install copper water services. This work will require the Contractor to make all taps for the service, install new copper pipe, and install either 1-inch corporation stops or 2-inch gate valves. See Standard Details 503 and 504.

All direct taps made to the waterline for 1-inch corporation stops shall be made with a tapping bit with cc threads and with a machine designed for that purpose.

Where new 1-inch copper service pipe is to be installed at the existing meter locations, the new angle meter stop shall be set at the same elevation as the existing angle meter stop with a maximum of 2-inches away from connection point on the existing meter. All new copper pipe and service fittings shall be kept clean and free of debris. City Water Operations crews will make connection of new angle meter stop to existing meter. City Water Operations crews shall only have to remove the existing angle meter stop, connect the new angle meter stop, and flush the new service. Any extra time and materials required due to the Contractor's negligence shall be recorded and charged to the Contractor. New meter box, Armorcast, or approved equal will be installed by Contractor when existing meter box is damaged or broken.

Where new services are installed, new meter boxes shall be set with the top of the box at finish grade. The longest dimension of the box shall be set perpendicular to the adjacent curb. Where an existing meter must be relocated, Contractor shall provide and install the new copper service, angle meter stop, and meter box complete and adjusted to finished grade. City Water Operations crew will install the meter and extend or shorten customer's service line on the consumer's side of the meter. Where a meter is located within a traffic area, including driveways and aprons, a traffic bearing meter box, Old Castle #37, or approved equal, and reader lid shall be supplied at no additional cost.

All copper and brass structures shall be bedded with $\frac{3}{4}$ "-0" crushed aggregate to a depth of 6-inches on all sides and backfilled in accordance with Standard Details 503 and 504. However, the interior of the meter box shall be backfilled with soft earth, free of gravel and organic matter.

Service lines shall be located in a direct line between the meter and a point on the main directly opposite the meter. Meter shall be located 18-inches inside side lot line. Lot line shall be projected perpendicular to curb. Service lines shall have a minimum cover of 30-inches, except where crossing road ditches where the cover may be reduced to 24-inches at said road ditch.

Where existing copper service is to be transferred to new main, and the existing main is to remain live; City Water Operations crew shall disconnect corporation stop from old main and install a brass plug. Contractor shall provide excavation down to old corporation stop, install select backfill, and compact. Excavation and backfill shall be considered incidental to the project. On publicly financed improvement projects the Contractor shall perform surface restoration according to the bid item for that work. Transfer of service to new main shall be performed by City crews once new waterline is tested and accepted. The Contractor shall provide new corporation stop in new main directly below location of existing service crossing.

All new services crossing existing metal gas lines or other cathodically protected systems shall have PVC sleeves as shown on Standard Details 503 and 504.

Corporation stops shall be set at a 30° angle up from horizontal with operating nut at 3 or 9 o'clock. Taps shall be a minimum distance of 18-inches from the bell or spigot end of the main, a fitting, or another service tap.

Where a new section of 1-inch copper service is to be installed, it shall be Type K seamless soft-annealed copper pipe conforming to ASTM B-88. 2-inch copper shall be Type K rigid pipe conforming to ASTM B-88. For 1-inch services, there shall be no splicing of copper unless service is longer than 100-feet or as approved by the Engineer (unique conditions). When splicing is approved between 2 pieces of copper, it shall be done with a 3-piece, copper-to-copper union. No more than 1 splice per service shall be made and splicing shall be made outside of the existing or proposed travel lane. Existing galvanized service lines encountered by the Contractor shall be entirely replaced with copper service pipe up to and through the angle meter stop.

No kinks, dents, abrasions, or deformations will be allowed in the copper. If any are discovered, the entire length of copper shall be replaced at the Contractor's expense. Each copper service shall be visually inspected by the Inspector upon completion, prior to backfilling.

Where 2-inch services for 1½-inch and 2-inch meters are to be installed, the new main shall be tapped 2-inches, a double strap 2-inch F.I.P. service saddle, 2-inch brass M.I.P. nipple, 2-inch R.W. F.I.P. gate valve and Mueller H-15428 M.I.P. x 110 CTS adapter installed, 2-inch copper tubing and 2-inch angle meter stop shall then be installed to the new meter location. Where meter box is located in any portion of a driveway or apron, or any other traffic area, a traffic-bearing box and reader lid shall be used. See Standard Detail 504.

Once the new copper services are installed by the Contractor and the new waterline facilities are pressure tested, chlorinated, and accepted, City Water Operations crews shall install new meter or relocate existing meters to their new locations and replumb the service. It shall be the responsibility of the Contractor to coordinate this with the Inspector. Placement of new sidewalks or other surface restoration shall not take place until meters and tailpieces have been installed.

503.08 PLACING PERMANENT BLOW-OFF ASSEMBLIES

A standard 2-inch blow-off assembly shall include, but not be limited to, a main size cap tapped 2-inches I.P.T., "Megalug" retainer gland, or approved equal 2-inch x 6-inch brass nipple, 2-inch RW gate valve, 2-inch galvanized 90° bend, 2 valve boxes with lids, and 2-inches Schedule 40 galvanized pipe and PVC plug.

A 4-inch or 6-inch blow-off assembly shall include, but not be limited to, a main size x 4-inch or 6-inch MJ x flange reducer, "Megalug" retainer gland, or approved equal flange x flange RW gate valve, companion flange, galvanized 90° bend, schedule 40 galvanized piping, 2 valve boxes with lids, galvanized coupling and PVC plug.

The blow-off assembly shall be placed as shown in Standard Details 507A or 507B and securely blocked with concrete or mechanically restrained as required.

The mainline pipe shall be thrust restrained with a straddle block as shown on Standard Detail 510 or mechanically restrained. Blow-off pipe and fittings shall remain fully accessible for repair and replacement without disturbing the permanent waterline.

503.09 PLACING COMBINATION AIR VALVE UNITS

An air-release-valve unit shall consist of all items as described in **Subsection 502.15** and as noted on Standard Detail 506.

The combination air valve unit shall be placed as shown on the plans, secure in place with concrete block, and all crushed gravels compacted as specified. Placing the combination air valve unit shall consist of transporting, assembling, and placing of the complete unit, tapping the water main, excavating and backfilling as specified, servicing, and all surface restoration.

503.10 REMOVING EXISTING WATER WORKS MATERIALS

When the Contractor removes existing pipe, gate valve units, fittings, fire hydrant units or other items to allow installation of the work specified herein, Contractor shall haul the removed water works materials to the City's designated storage yard unless otherwise directed by the Engineer. Title to the removed materials shall remain with the City unless otherwise designated by the Engineer. If directed, Contractor shall be responsible for disposal of materials.

503.11 ABANDONING EXISTING MAINS AND VALVES

Any existing waterlines that are abandoned shall be severed and plugged with non-shrink grout, or as directed in the field by the Inspector. All abandoned valve boxes shall be removed and the riser cut off 12-inches below grade, gravel-filled, and asphalt-plugged at no additional cost to the City.

503.12 MAINTAINING SERVICE

The Contractor shall schedule construction work specified herein to maintain continuous water service to existing water users. Where it is necessary to shutdown service to make required inter-ties, the Contractor shall coordinate with the Inspector at least 2-working-days prior to a planned water service shutdown to allow the City to notify users of the impending interruption of water service. More notice may be required by the Engineer.

The Inspector shall notify both Fire & Emergency Services Department and Water Operations. The Contractor may be required to make necessary service shutdowns of affected businesses after regular business hours at no additional cost to the City.

503.13 FLUSHING

The new pipeline, which includes all fittings, valves, services, and fire hydrants, shall be: (1) flushed at a minimum of 2.5 FPS, (2) pressure tested, and (3) disinfected, in this order, before any connection to the existing water system is made. Blow-offs shall be provided by Contractor at all dead-ends and points of connection to the existing system as shown on Standard Details 507A and 507B. A temporary fill point shall be provided by the Contractor as shown on Standard Detail 507C for filling, flushing, pressure testing, and chlorinating the new water system. The new waterline shall be built as close as possible, as determined by the Inspector, to the existing water system at points where connections are to be made. Blow-offs shall be located at high elevation points and fill points shall be located at low elevation points where practical.

All water used during flushing, pressure testing, and chlorinating shall be metered and billed to Contractor. Metering device shall be installed by the City at the same time and location as the double check assembly.

Prior to any flushing procedures taking place, the Contractor may be required to submit a flushing plan providing direction of flow, water damage control, and a written schedule to the Engineer for approval. A minimum 48-hour notice shall be given to the Inspector prior to any system shutdown or flushing procedures. Under no circumstance shall the Contractor operate any City valves without prior explicit approval by the Engineer.

The following chart shows minimum temporary blow-off/inlet sizes that shall be provided by the Contractor. Gate valves shall be provided on blow-off and inlet pipes to pressure test against, and to keep the pipe interior clean when backflow assembly is removed. See Standard Details 507A, 507B, and 507C.

Contractor is required to de-chlorinate all water flushed onto the street surface or into any storm drain system. Dechlorination process shall be approved by Engineer of Record prior to flushing.

REQUIRED OPENINGS TO FLUSH PIPELINES		
NOMINAL PIPE SIZE (INCHES)	FLOW REQUIRED TO PRODUCE 2.5 FPS VELOCITY (GPM)	MINIMUM INLET & OUTLET PIPE SIZE REQUIRED (INCHES)
4	110	2
6	240	2
8	430	4
10	660	4
12	950	4
14	1290	6
16	1690	6
18	2140	6
20	2640	6
24	3800	6

All flushing and testing water shall be delivered to the new waterline through Oregon Department of Human Services, Health Services approved double check valve backflow prevention assemblies.

The City can provide a 2-inch or 6-inch double check backflow assembly, or Contractor may provide an assembly. Certified backflow tester shall test assembly and furnish documentation to the Inspector indicating a passing test after assembly is installed onsite and before it may be used.

Contractor shall coordinate with the Inspector at least 5-working-days in advance of when the backflow assembly will be needed onsite.

After flushing, the new system shall be pressure tested and disinfected.

503.14 PRESSURE TESTING

After being installed, all of the pipe, fittings, services, fire hydrants, and all individual closed valves, except the last connection with the existing main, must be pressure tested, conforming to AWWA C600 Section 4 Specifications except as noted. The pipeline may be divided into sections and tested in stages at the option of the Contractor. If the Contractor elects to test the line in sections, the lengths of the sections and provisions for testing shall be subject to approval by the Engineer.

Before testing the pipeline for leakage, the pipeline shall be properly restrained. The interior of the pipeline shall be thoroughly cleaned to remove all foreign matter.

The Contractor shall furnish necessary thrust blocks, pumps, medium range pressure gauges, means of measuring water loss, and all other equipment, materials, and labor required for making the tests. Pressure gauges shall be graduated to a minimum of 1psi increments.

All air vents shall be open during the filling of the pipeline with water. After a test section is completely flushed and filled, it shall be allowed at the Contractor's option to stand under slight pressure for 24-hours to allow the lining to absorb what water it will and to allow the escape of air from any small air pockets. During this period, the bulkheads, valves, and exposed connections shall be examined for leaks. If any are found, they shall be repaired. The pressure shall then be raised slowly to the hydrostatic pressure of 150 pounds per square inch, or 1.5 times the normal working pressure, whichever is higher, measured at the point of highest elevation, and shall be maintained for a period of at least 1-hour, beginning at a time of day to be mutually agreed upon between the Contractor and the Inspector.

The Contractor may elect to test the pipeline in sections in order to prevent excessive pressure in the lower section of pipe being tested. Test pressure shall not exceed 150% of pipe pressure rating.

The acceptable leakage allowance shall be ½ of AWWA C600 Section 4 Specifications. While the pipe is under pressure and regardless of whether or not the measured leakage is within allowable limits as set forth, an inspection for leaks along the pipeline shall be made by the Contractor. Any leaks found shall be recorded and shall be repaired by the Contractor. All such repairs shall be made subject to the approval of the Engineer and in the presence of the Inspector.

The Contractor, at no expense to City, shall perform any excavation required to locate and repair leaks or other defects that may develop under the test. He shall remove backfill and paving already placed, shall replace such removed material, and shall make all repairs necessary to achieve the required water-tightness.

If any considerable leakage has been discovered or if the measured leakage exceeds the limit stated, the Engineer shall require one or more re-tests after repairs have been made. All repairs and re-tests shall be made at the Contractor's sole expense.

Once the entire system or section has passed the 1-hour pressure test, the Contractor shall then proceed testing each individually closed valve within the new system. Individually closed valves shall be pressure tested for a minimum of 15-minutes using the same rate of loss criteria stated above. If any valves are found to not hold pressure, they shall be operated, repaired or replaced, and retested until they pass.

All leakage tests shall be made in the presence of the Contractor and the Inspector.

503.15 CHLORINATION

The pipeline fittings and valves shall be thoroughly chlorinated and flushed in accordance with the Oregon Department of Human Services, DWP, O.A.R. 333-061 and AWWA C651. All chlorinated water shall be discharged into the public sanitary sewer system. If a sanitary sewer is not available, the Contractor shall employ the use of storage tanks, basins, or other means to transport or treat the chlorinated water for discharge to an approved point of disposal. Adequate quantities of chlorine in a water solution shall be added to the pipeline and shall be allowed to stand a sufficient length of time to disinfect the interior of the pipeline, but not less than 24-hours. The chlorinated water shall be flushed from the pipeline and, 24-hours after flushing, a water sample(s) shall be taken by the Inspector from various points along the pipeline and at the extremities. No hose or fire hydrant shall be used to collect samples. The water samples shall be tested biologically and an acceptable certification that the water is safe for domestic water consumption shall be obtained before placing the pipeline into service. If the initial samples fail to produce satisfactory bacteriological results, the Contractor shall re-chlorinate and re-flush the line and take new samples, at no expense to the City, until an acceptable, safe-water certification is obtained.

Chlorine shall be applied by the use of calcium hypochlorite and water mixture. The chlorination agent shall be applied at the beginning of the section adjacent to the feeder connection and shall be injected through a corporation stop, hydrant, or other connection, ensuring treatment of the entire line. Water shall be fed slowly into new line with chlorine applied in amounts to produce a dosage greater than 25-parts per million (PPM) but not more than 50-PPM throughout the system. After 24-hours, a residual of not less than 10-PPM shall be produced in all parts of the line. If the check measurement taken after the 24-hour period indicates a free chlorine residual of less than 10-PPM, the system shall be flushed, re-chlorinated, and rechecked until a final residual of 10-PPM or more is achieved and at no expense to the City.

During the chlorination process, all valves, fire hydrants, and services shall be operated. All parts of the line and services shall be chlorinated. After chlorination, the water shall be flushed from the line at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. At no time can chlorinated water be discharged to the stormwater system or a waterway.

The Contractor shall furnish and place all necessary fittings required for the testing, chlorinating, and flushing of the pipeline. See Standard Detail 507C.

503.16 CUT-IN AND CONNECTION TO EXISTING MAINS

After a new waterline is flushed, pressure tested, and disinfected, but prior to any cut-in and connects, Contractor shall hold an onsite pre-connection meeting. Those to attend shall include the onsite foreman, the Inspector, City Water Operations personnel, and the Engineer.

This meeting shall take place prior to each connection but not longer than one-week prior to the connection. At this meeting Contractor shall have all fittings, pipe, chlorine swabbing equipment, pumps and hoses, and all equipment needed to make the cut-in and connect. Cut-in schedule and coordination shall be discussed.

Once the bacteria test has been passed, cut-ins and connections to the existing water system shall be made. All fittings necessary for the cut-in and pumps adequate to handle water in the trench shall be on hand and ready for service before connection is commenced. If the new waterline is opened to the air before Contractor and City personnel are ready to proceed with the connection, or if new waterline is contaminated by dirt or dirty water, the new waterline shall be disinfected again. All work associated with cut-in and connections shall be done in the presence of the Inspector.

Fittings and pipe for cut-ins shall be cleaned and swabbed-out thoroughly with a 1% chlorine solution (one-half pound of 64% calcium hypochlorite in 4-gallons of water). Swabbing equipment shall be new and solution shall be kept clean and fresh.

During each connection, work shall proceed until the connection is completed and water service is turned back on. Groundwater shall not be allowed around any of the existing piping during the connection.

Where connections are made between new ductile iron waterline and a waterline of similar O.D., a long-pattern, mechanical-joint sleeve shall be used. Where connections are made between new ductile iron waterline and a waterline of the same nominal diameter but a different O.D., a transition coupling as manufactured by Dresser, Rockwell, or approved equal shall be used.

After the connection is completed and water service is turned back on, Contractor shall dry all fittings. A visual leak inspection of all fittings shall be done by the Inspector prior to backfilling. Visual inspection shall be done in such a manner that any amount of leakage may be detected.

503.17 IMPERVIOUS DAMS

In areas where waterline is installed outside of paved surface, or where indicated on the plans, or as directed by the Inspector, the Contractor shall place impervious dams to prevent groundwater movement along the trench. Dams shall be made of impervious backfill material composed of particles at least 50% of which pass a No. 200 sieve and with a plasticity index not less than 20, unless otherwise approved by the Engineer.

In areas where waterline is installed under existing or future paved surface, or where indicated on the plans, or as directed in the field by the Inspector, the Contractor shall place control density backfill (CDF) dams to prevent groundwater movement along the trench. CDF shall meet specifications as outlined **Section 206**.

A dam shall fill the trench completely from side to side and top to bottom, except for the volume occupied by the pipeline and any materials required for surface restoration. Pipe in contact with clay or CDF dam shall be wrapped with two layers of 8-mil polyethylene.

503.18 CORROSION CONTROL INSTALLATION

503.18.01 Exothermic Welding and Underground Electrical Connections

Refer to Standard Detail 521.

Exothermic Weld: The electrical connection of copper wire to steel, ductile iron, and cast iron surfaces shall be by the thermite weld method. Before the connection is made, the surface shall be cleaned to bare metal by making a 2-inch x 2-inch window in the coating, and then filing or grinding the surface to produce a bright metal finish. After the weld connection is made, it shall be covered with a "gray pad" as manufactured by

Tapecoat, or approved equal as shown on Standard Detail 520. Any damage to the pipe coating or lining shall be repaired according to the coating manufacturer's recommendations.

503.18.02 *Test Station Installation*

Refer to Standard Details 522 through 526.

On all metallic and metallic-reinforced pipelines that are specified to be joint-bonded or are otherwise electrically continuous, install test stations of the type indicated and locate as shown on the plans and as specified herein. Where possible, locate test stations near existing structures such as telephone and power poles or fire hydrants.

Unless specified otherwise by the Engineer, locate test stations as follows:

1. General – Install typical test stations as appropriate to maintain 1,000-foot maximum intervals.
2. Foreign – Where the City's pipeline crosses at any clearance, a foreign-owned pipeline that is cathodically protected or is 12-inches or larger in diameter.
3. Insulating Connection – At all buried connections between bonded and unbonded pipe (Standard Detail 526), except insulated service connections where the service line diameter is 2-inches or less.
4. Cased Crossing – At all cased crossings. For casings 50-feet long or less, install one test station. For casings over 50-feet long, install one test station at each end of the casing.

Test station wire shall be color-coded as specified or shown on the plans. Wire can be color-coded with colored plastic electrical tape. Wrap tape around wire with a 50% overlap over the last 6-inches of the wire before the terminal connector. Test station wires shall be encased in rigid PVC conduit from the pipeline to the test station box.

503.18.03 *Installation of Reference Electrode Cells*

Use water in the installation of reference electrode cell according to the electrode manufacturer's instructions, unless specified otherwise. Install reference electrode at the depth of the centerline of the water main and 6-inches away from the outside of the pipe. Do not install the electrode cell within 3-feet of a neighboring metallic structure. Compact the backfill around reference cells to 95% of maximum density as determined by AASHTO T-180.

503.18.04 *Galvanic Anode Installation*

Unless specified otherwise, anodes shall be installed 1-foot below the pipe invert and 5-feet perpendicular to the edge of the pipe or alternately 5-feet below the pipe invert and up to 3-feet perpendicular from the pipe edge. Do not place the anodes within 3-feet of a neighboring metallic structure. When anodes are distributed along the pipeline, alternate the perpendicular offset from one side of the pipe to the other. Install the anode in clean, native backfill and not in the select bedding material. Compact the soil to 95% of maximum density as determined by AASHTO T-180.

503.18.05 *Wiring*

All wiring is to be splice-free, except where splices are specified or shown in the plans. All underground connections must be pre-approved in writing by the Engineer. Coil and snake buried wire in a slack fashion to prevent stress from backfill operations and earth settlement. All wire is to be buried a minimum of 30-inches below finish grade and installed in rigid conduit. All wire connections to test station terminal boards are to be made with crimp-on ring terminals. Repair any damage to the wire insulation with 2-layers of self-adhering butyl rubber electrical tape Scotch No. 130C, or approved equal, and over-wrap with 2-layers of vinyl electrical tape Scotch

No. 88, or approved equal. Spirally apply each layer at 50% overlap. This repair method is not applicable to repair of anode wire for impressed current systems.

503.18.06 *Continuity Testing*

When specified, perform electrical continuity testing and record test data as specified by the Engineer. Repair any joint not passing the electrical continuity test at no cost to the City.

503.18.07 *Foreign Pipeline Coordination*

Coordinate indicated welds to foreign pipelines with proper authorities governing the pipeline. Contractor is responsible for obtaining necessary approvals and coordination.

503.18.08 *Polyethylene Encasement*

When specified, install polyethylene tube type encasement on all pipe and appurtenances. Install this encasement in accordance with AWWA C105 Method A – one length of polyethylene tube for each length of pipe. The use of polyethylene sheets will not be allowed.

503.19 *PLACING WATERLINE MARKERS*

Install permanent flexible plastic waterline markers above the centerline of the water pipe wherever the waterline lies in an easement or off-road area. Install markers spaced a maximum of 200-feet apart, at all changes in direction of the waterline, at each crossing with the public right-of-way line at blow-offs as shown on the plans, and directed by the Engineer. Install flat side of marker perpendicular to centerline of waterline. Install marker in a plumb position with 2-feet buried and 4-feet exposed. In paved areas in easements, brass surveyor's monument caps shall be permanently installed in the pavement in lieu of the plastic markers. See Standard Detail 517.

503.20 *TRACER WIRE*

Copper tracer wire is required to assist in locating waterlines in easements, off-road areas, and road areas on transmission mains where there are few or no services. Tracer wire shall be provided in lengths sufficient so that no splices will be required. As shown on the plans or directed by the Engineer, install copper tracer wire in the trench directly on top of the pipe for the entire length of the waterline. In off-road areas, wire shall be brought vertically to the surface at 400-foot intervals and fastened to the plastic waterline marker. A ¼-inch galvanized bolt and nut shall be installed in a ⅜-inch hole drilled in the marker 1-foot above the ground surface. The tracer wire on each side shall be looped twice around the bolt and a 1-foot piece of free wire left on the end. Where the 400-foot interval falls in a paved area in an easement, the tracer wires shall be brought up into a meter box with traffic lid as described below.

For transmission mains in road areas, provide and install a tracer wire station behind the curb at 400-foot intervals and as shown on the plans or directed by the Engineer. Tracer wire station shall consist of a meter box and lid (Armor cast), 2-inch PVC conduit to house the wire, and copper wires tracing the upstream and downstream waterlines. From the top of the water pipeline, tracer wires shall be brought up vertically to a depth of 30-inches of cover, then run horizontally, perpendicular to the waterline at a depth of 3-feet, over to the meter box, and vertically into the box where a 2-foot length of free wire on the end of each tracer wire shall be coiled. From the top of the water main to the inside of the meter box, tracer wires shall be housed in 2-inch PVC electrical conduit. Install minimum 1-foot radius sweep at each change of direction of the conduit. Allow sufficient slack in the wire that stress will not be placed on the wire during backfilling operations. A 3-inch thick concrete pad shall be installed around each tracing station box where not in sidewalk area. Pad shall measure a minimum of 12-inches from the outside of the box to the outside edge of the concrete pad. See Standard Detail 517.

504 MEASUREMENT FOR PAYMENT
(Not applicable for privately financed public improvements)

504.01 INSTALLATION OF PIPE

Pipe installation shall include furnishing of pipe; water works materials required for proper installation; standard or restraint gaskets; pipe zone and bedding material; impervious dam material; transportation to the job site; all required excavation to the depth designated on construction plans; disposal of excavated materials not re-used; shaping the bottom of the trench for proper bedding of the pipe; wrapping with polyethylene encasement; cutting, placing, and testing pipe; furnishing chlorine or chlorine compounds; disinfection; flushing the pipe line; furnishing, placing, and removing temporary thrust blocks, blow-off units, and temporary plugs and caps; ground water control; placing and compacting pipe zone, bedding, impervious dams and backfill material; and incidental traffic control. Where PVC pipe is installed, installation price shall also include tracer wire. Pipe installation shall also include providing and installing plastic or brass waterline markers, copper tracer wire, and tracer wire stations.

Pipe installation shall be paid on a lineal foot basis and measured along the centerline of the pipe installed. The laying length of gate valves, fittings, and other appurtenances shall be included in the pipe centerline measurement. Backfill shall be paid under separate bid items on a per-cubic-yard basis for the class of backfill used, outside of bedding, pipe zone, and pavement base rock areas. See Standard Detail 502 and also **Section 206**.

Payment for over-excavation shall begin once the extra depth reaches 18-inches below the designed grade, and shall only include the excavated material lower than 18-inches below design grade.

504.02 CAST IRON AND DUCTILE IRON FITTINGS

Payment for the cost of furnishing and installing cast iron and ductile iron fittings, in addition to that amount paid for the laying length of the fitting under the pipe item, shall be paid for on a per-each basis as listed in the Contract Documents. Payment shall include all accessories installed complete in-place. Follower glands and mechanical restraint retainer glands are to be considered accessories and are not paid for separately.

504.03 CUT-IN AND CONNECT TO EXISTING MAIN

Connections that require cutting into existing lines shall be paid for as bid in the Contract Documents for cut and connect to existing main. Existing line sizes shall be field-verified by the Contractor before ordering fittings and undertaking the work involved in this item. Payment for the connections shall include removal of existing pipe, fittings, thrust blocking, and furnishing and installing all adapters, solid sleeves, spools, and excavation and clearing and grubbing necessary to make the connection. Valves, bends, tees, or crosses required for such connections shall be paid for separately as listed in the Contract Documents for valves and fittings respectively.

504.04 WET TAPPING OF EXISTING MAIN

Connections that require wet tapping of existing mains shall be paid for as bid in the Contract Documents for wet tapping of existing main. Existing line sizes shall be field-verified by Contractor before ordering materials and undertaking work involved in this item. Payment for this item shall include providing tapping tee, resilient wedge gate valve, tapping of main, any extra adapters, sleeves, and spools, and all excavation required to make tap and connect new waterline.

504.05 COPPER SERVICE INSTALLATION

Copper service installation shall be paid on a per-each basis by size. The unit price quoted shall include furnishing all materials and work necessary to either transfer existing service or install new copper service pipe, tapping the new main, installing corporation stop or gate valve, and all other materials as shown on Standard Details 503 and 504. It shall also include excavation, boring, backfill, temporary patching, pavement cut and repair, groundwater control, and other incidental work items complete in-place.

504.06 BLOW-OFF ASSEMBLIES

Payment for the blow-off assembly shall include furnishing, transporting, assembling, and placing of the complete assembly as shown on Standard Details 507A and 507B, plus backfill and compaction. Main line straddle blocking shall be paid under separate bid item. Mechanical restraint shall be absorbed into the cost of the blow-off assembly and waterline bid items.

504.07 COMBINATION AIR VALVE UNIT

Payment shall be on a per-each basis and shall include, but not be limited to, a 2-inch service saddle, 2-inch corporation stop with ¼-bend adapter, 2-inch rigid copper tubing (ASTM B-88, Type K), 2-inch combination air valve, 48-inch concrete manhole cone with frame and lid and any other appropriate fittings needed for plumbing the valve as described in **Subsection 502.15**, or as noted on the Standard Detail 506. Payment shall also include excavation and backfill, but pavement and sidewalk cut and repair each shall be paid for separately as described in the Contract Documents. All materials used shall be of the type as designated in **Subsection 502.15** and Standard Detail 506.

504.08 FIRE HYDRANT ASSEMBLY

Bid item shall include furnishing and installing hydrant, gate valve, “Megalug” retainer glands, valve box, and painting as shown on Standard Detail 501 and described in **Subsection 503.06**. 6-inch ductile iron and tee for fire hydrant shall be paid for separately.

504.09 OVER-EXCAVATION

Over-excavation shall be paid by the cubic-yard based on the volume of the trench excavated. The quantity measured for payment of over-excavation shall begin once the extra depth reaches 18-inches below the designed grade and payment shall be only for the material lower than 18-inches below design grade.

Payment for over-excavation shall include excavating the trench, disposing of material removed, placing and compacting select backfill material, shoring, and other requirements for working at a greater depth. Provision for select backfill, crushed aggregate for over-excavated areas shall be paid for by the cubic-yard as provided for elsewhere in the Contract Documents.

504.10 SANITARY SEWER CROSSINGS

Centering a length of water pipe over each sanitary sewer crossing shall be considered incidental to construction and no additional payment shall be made.

Replacement of existing sanitary sewer lateral shall be paid on a per-each basis and shall include all excavation, piping, couplers, bends or fittings, connection to main, grouting, select backfill, surface restoration, and all work needed to replace the lateral and install in-place. See Standard Detail 511.

504.11 WATER QUALITY SAMPLING STATION

Payment for sampling station shall be on a per-each basis and shall include furnishing and installing all materials, complete-in-place, as shown on Standard Detail 505, including but not limited to excavation, backfill, pavement cut and repair, groundwater control, testing, and other incidental work items. Sidewalk cut and repair shall be paid for separately if provided for in the Contract Documents.

504.12 CORROSION CONTROL

Any items under this section that are specifically shown as bid items in the Contract Documents will be bid and paid accordingly. All items under this section that are not specifically shown as separate items in the Contract Documents must be included in the price bid for the pipeline and no additional payment will be made for them. The bid prices, whether covered as separate items or as part of the pipeline price, include all costs for labor and materials

required for a complete installation as shown on the plans, Standard Details, and as described in the Contract Documents.

Payment for bid item “Ductile Iron Pipe, CL.52, Bonded and Poly-wrapped” shall include all materials and labor for joint bonding, exothermic welding, continuity testing, polyethylene encasement, and any other corrosion control measures shown on the plans or described in the Contract Documents, in addition to the work described in ***Subsection 504.01***, Installation of Pipe.

Payment for test stations shall be made on a per-each basis under the bid item “Install Test Station”, and shall include all labor and materials to install test station wires, thermo-welding, rigid PVC conduit, test station box, terminal board, excavation and backfill, groundwater control, landscape restoration, A.C. pavement cut and repair, continuity testing, and other incidentals.

Payment for providing and installing dielectric insulating connection between bonded and unbonded pipe shall be absorbed into the bid item, “Cut-In and Connect to Existing Main.”

504.13 OTHER ITEMS

Unless otherwise specified on the plans or in the Contract Documents, valve units, fire hydrant units, blow off units, air release valve units, connections to existing mains, and services shall be paid on a per-each unit basis for furnishing and installation of the unit complete in-place, tested, and ready for service.

Items that are specifically listed in the Contract Documents will be bid and paid accordingly. All items that are not specifically shown as separate items in the Contract Documents must be included in the price bid for the pipeline, and no additional payment will be made for them. The bid prices, whether covered as separate items or as part of the pipeline price, include all costs for labor and materials required for a complete installation as shown on the plans and described in the Contract Documents.

****END OF DIVISION****

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601 SUBGRADE

601.01 DESCRIPTION

This section covers work necessary for preparation of the subgrade, complete. See also *Section 204* and *Section 206*.

Subgrade is defined as the area of new or existing roads, streets, the alleys, driveways, sidewalks, or other locations upon which additional materials are to be placed as a part of work or by future work. Where applicable, subgrade may be considered to extend over the full width of the specified base course.

601.01.01 Untreated Subgrade

The material placed in fills or unmoved from cuts in the normal grading of the roadbed, and that is brought to true line and grade, shaped and compacted, as required by these specifications to provide a foundation for the pavement structure.

601.02 MATERIALS

601.02.01 Water

Conform to the requirements in *Subsection 205.02.03*.

601.03 CONSTRUCTION

601.03.01 Preparation of Subgrade

Subgrade upon which pavement, sidewalk, curb and gutter, driveways, or other structures are to be directly placed shall not vary more than .05-feet from the specified grade and cross section. Subgrade upon which subbase or base material is to be placed shall not vary more than .10-foot from the specified grade and cross section at any point. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.

Blade and shape subgrade to meet grade and cross sections shown on plans.

Prior to starting subgrade work, including backfill, all underground work contemplated in the area of the subgrade shall be completed. This requirement includes the Contractor's work and work to be performed by the City or by others.

The Contractor shall remove all soft or otherwise unsuitable material as directed and replace with approved material. The Contractor shall compact to a line 1-foot beyond the edge of paving, curb, or form.

Subgrade areas that cannot be compacted to specified density but, in the judgment of the engineer, otherwise meet the requirements herein, may be removed and aerated or stabilized with an approved soil stabilizing material – all at no additional expense to the City.

Subgrade materials that cannot be compacted to specified density due to excess moisture shall be dried out to bring materials to $\pm 2\%$ of optimum moisture. The Contractor shall aerate, drain, re-handle, amend with lime or cement, or by other means at his option remove the excess moisture. All costs involved in the removal of excess moisture from the material are the responsibility of the Contractor for which no additional payment will be made.

601.03.02 *Grading of Areas Not to be Paved*

When specified, areas within and adjacent to the project that are intended for lawns, planting areas, flower beds, and similar uses shall be finished with 4-inches of topsoil and graded smooth as directed. Topsoil for such finishing shall be fertile, loamy, natural-surface soil consisting of sands, silts, clays, and organic matter and shall be free of toxic substances, weeds, roots, refuse, sticks, large rocks, or lumps. Topsoil available from required excavation shall be used to the greatest extent possible in this work. The premature disposal of suitable topsoil material shall be prohibited.

601.03.03 *Over-excavation and Foundation Stabilization*

When, in the opinion of the Engineer, unsuitable material or other conditions are discovered that render the subgrade unable to be compacted to the specified density, then the Engineer may order the Contractor to remove and dispose of the unsuitable material and then backfill with crushed rock as specified in the applicable portions of **Section 206**. Geotextiles may be required before backfilling.

601.03.04 *Embankment Construction*

The Contractor shall place embankments and fills of all kinds in approximate horizontal layers of a maximum of 12-inches in thickness and compact each layer separately and thoroughly to the density specified.

In the immediate vicinity of curbs, walks, driveways, inlets, manholes and similar structures, holes, and where embankment and fill materials cannot be reached by the normal compacting equipment, the Contractor shall compact to specified density by approved methods.

Where embankments are constructed predominantly of rock fragments, the Contractor shall place material in layers of the thickness as directed by the Engineer of Record, but not greater than 3-feet. Placing of individual rock fragments having dimensions greater than 3-feet may be permitted upon approval of the Engineer, provided they have no dimensions greater than 6-feet, that clearances between adjacent fragments provide adequate space for the placing and compacting of material in horizontal layers as specified, and that no part comes within 4-feet of subgrade. The Contractor shall distribute and manipulate rock so that the space between the larger pieces is filled with smaller material, forming a dense and compact mass.

The Contractor shall exercise caution to ensure that embankment construction and fill does not move, endanger, or overstress any structure. The Contractor shall place and compact embankments at the end of bridges prior to the time that work begins on the bridge. When placing material against an existing slope face, Contractor shall terrace and key each 4-foot of fill.

Embankments shall not be constructed when the embankment material, or the embankment on which it would be placed, is frozen.

601.03.05 *Slides and Slip-outs*

Material outside the planned roadway or ditch slopes that, in the opinion of the Engineer, is unstable and constitutes potential slide material that may come into the roadway, channel, or ditch, and material that has slipped out of new or old embankments shall be excavated and removed. The material shall be excavated to designated lines or sloped either by benching or in such a manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer.

The above provisions shall not be so construed as to relieve the Contractor of his obligation to maintain all slopes true and smooth.

601.03.06 *Slopes*

Excavation and embankment slopes shall be finished in conformance with the lines and grades shown on the plans.

601.03.07 *Finishing and Cleanup*

All roadbeds, planting areas, ditches, embankments, and other areas on which earthwork is performed shall be trimmed reasonably close to established lines, grades, and cross sections and shall be finished in a thoroughly workmanlike manner. They shall be kept free, throughout the work, of debris and foreign matter of all kinds; prior to final acceptance the entire right-of-way shall be cleaned up and finished as directed by the Project Manager.

601.03.08 *Compaction and Density Requirements*

The density of compacted materials in-place will be determined by nuclear densometer or other methods as approved by the Engineer, and the maximum density will be determined by AASHTO T-180.

The Contractor shall compact all embankments, fills, and backfills within 3-feet of established subgrade elevation to a minimum density in place of 95% of maximum density. Below said 3-foot limit compaction shall be a minimum density in-place of 90% of maximum density.

Roadbed cuts and foundations for structures to a depth of 1-foot below established subgrade or foundation elevation shall be 3-inch maximum material and shall be compacted to a minimum density in-place of 95% of maximum density.

601.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

601.04.01 *Measurement*

601.04.01A *Incidental Work*

No measurement will be made for work involved in draining water from the subgrade, grading the subgrade in preparation for staking, or blading, shaping, and compacting the subgrade, including roadbed materials to a depth of 12-inches below the subgrade, to final line, grade, and cross section. All work involved in these processes will be considered incidental to and included in the various other items of work in the Contract Documents.

Water used in the work (compaction, dust control, etc.) will be considered incidental to and included in the various other items of work in the Contract Documents.

601.04.01B *Untreated Subgrade*

No measurement and payment will be made for preparation of untreated subgrade unless otherwise provided.

601.04.01C *Over-excavation and Foundation Stabilization*

Measurement for over-excavation and foundation stabilization will be made on "neat line", cubic-yard basis for quantities removed.

601.04.01D *Embankment Measure*

Embankment in-place will be measured by the cubic yard of embankment as set forth below.

The pay quantities of "embankment in-place" will be determined by cross-section measurement of the material in place in final embankment position in the work as specified and in accordance with the directions of the Project Manager. The pay quantities of "embankment in-place" will be limited

to the neat lines of specified cross-sections, lines, grades, and slopes, and above the ground or base elevations existing at the time embankment construction thereon begins. The pay quantities will not include additional quantities required due to subsidence and settlement of the ground or foundation, or to settlement of materials within the embankments, or to shrinkage, settlement, washout, slippage, or loss, regardless of cause.

There will be no measurement of overhaul on "embankment in-place" materials.

601.04.02 *Payment*

601.04.02A *Over-excavation and Foundation Stabilization*

Payment for over-excavation and for foundation stabilization will be made on a cubic-yard basis.

601.04.02B *Embankment In-place*

Payment for "embankment in-place" will comprise full compensation for the excavating, selecting, handling, hauling, placing, and compacting of the materials and all other costs incurred in the construction of the embankments involved.

602 WATERING

602.01 *DESCRIPTION*

This section covers work necessary to furnish and apply water for roadway excavations, fills, subgrades, roadbeds, backfill, subbases, bases, and surfacings, and water used for the alleviation or prevention of dust within the project limits.

602.02 *MATERIALS*

602.02.01 *Water*

Conform to the requirements in *Subsection 205.02.03*.

602.03 *CONSTRUCTION*

The Contractor shall make all arrangements necessary for the procurement of water and its application. The Contractor shall obtain a hydrant meter from the City for the purposes of measuring all water used on the project.

Water by means of tank trucks equipped with spray bars, by hose and nozzle, or by other approved equal means that ensure uniform and controlled application. The use of splashboards will not be permitted without prior approval.

Perform watering at any hour of the day and on any day of the week as necessary. Make all necessary arrangements and pay all costs for obtaining water. Maintain an adequate supply of water at all times to complete the required work.

602.04 *PAYMENT*

602.04.01 *Water*

When neither specified nor shown in the Contract Documents for separate payment, all water will be considered incidental to the other items of work and no separate payment will be made.

603 AGGREGATE BASES

603.01 DESCRIPTION

This section covers work necessary to furnish and place all courses of aggregates and water, as base, on a prepared surface.

603.02 MATERIALS

Aggregates for aggregate base shall be crushed rock. Aggregate for subbase shall be crushed rock or, if approved by the Engineer, sand may be used.

603.02.01 Aggregate

Coarse and fine aggregates shall conform to requirements of *Section 205* and to additional requirements contained herein.

603.02.02 Sand Equivalent

Base aggregates to be incorporated in the work shall have a sand equivalent of not less than 50 when tested in conformance with AASHTO T-176.

603.02.03 Liquid Limit and Plasticity

Base aggregate shall meet the requirements for liquid limit and plasticity index of *Subsection 205.02.04C*.

603.02.04 Grading Requirements

The base aggregates shall be uniformly graded from coarse to fine and shall conform to requirements of *Subsection 206.02.05A* and additional requirements contained herein.

603.02.05 Acceptance

Acceptance will be based on periodic samples taken following mixing or placement.

603.03 CONSTRUCTION

603.03.01 Preparation of Subgrade

Ensure that all surfaces and materials on which subbase or base is to be constructed are firm and have been prepared as specified in the applicable portions of *Section 601*.

603.03.02 Mixing

Mix to provide a homogeneous mixture of un-segregated and uniformly dispersed materials that will compact to not less than 95% maximum density as specified in *Subsection 603.03.04*. Add water during mixing in an amount sufficient to provide optimum moisture content $\pm 2\%$.

603.03.03 *Placing*

603.03.03A *Weather Limitations*

When the weather is such that satisfactory results cannot be secured, the Contractor shall suspend operations. Place no surfacing materials in snow or on a soft, muddy, or frozen subgrade. The City will not be liable to damages or claims of any kind or description by reason of operations being suspended due to weather limitation.

603.03.03B *Equipment*

Furnish equipment that will provide for efficient and continuous operations insofar as practicable.

Aggregate bases shall be deposited on the roadbed at a uniform quantity per lineal foot so that the Contract will not resort to spotting, picking up, or otherwise shifting of aggregate base material. Segregation of aggregates shall be avoided and the material as spread shall be free of pockets of coarse or fine material.

Spreading equipment shall have an adjustable screed or strike-off assembly and it may have a receiving, mixing, and distribution system. It may be a complete and integral unit, self-propelled and powered; a crawler-track or wheeled type tractor intimately combined with a receiving, mixing, spreading, and screeding unit attached thereto; or a heavy-duty self-propelled grader, of an approved type, equipped with at least an 8-foot blade. Equipment shall be capable of spreading or striking off material to the designed line, grade, and transverse slope with surface texture of uniform appearance without excessive segregation or fracture of material.

Spreading equipment may be provided with an automatic control system if Contractor so elects or if specified.

603.03.03C *Thickness of Lifts*

If the required compacted depth of the base course exceeds 12-inches, construct in 2 or more layers of approximate equal thickness. Maximum compacted thickness of any 1-layer shall not exceed 12-inches. Place each layer in widths as wide as practicable and to full width of the course before a succeeding lift is placed.

603.03.04 *Compaction*

At the time compaction begins, the materials shall be at optimum moisture content $\pm 2\%$. Compaction of each layer shall continue until a density of 95% of the maximum density has been obtained according to AASHTO T-180. Water shall be added to the materials as necessary during the compaction to maintain the proper moisture content.

603.03.05 *Surface Finish*

Surface of the base shall parallel the established cross section and grade for the finished surface within 0.04-foot. The finished surface of base, when tested with a 12-foot straight edge, shall not vary from the testing edge by more than 0.04-foot at any point. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.

603.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

603.04.01 *Measurement*

603.04.01A *Square Yard Basis*

Measurement of aggregate base made on a square-yard basis will be made of width and length of each separately-constructed strip of aggregate base incorporated in the work and accepted wherein width is the design width or edge-to-edge width of aggregate base, whichever is the lesser, and length is from end to end along the center of the strip. Measurement shall be on the surface of the aggregate base to the nearest 0.1-foot and the square yardage shall be to the nearest full square yard.

Extra thickness of aggregate base, when directed by the Project Manager, will be measured by conversion on a proportionate volume basis to an equivalent number of square yards of specified standard thickness of base.

603.04.01B *Cubic Yard In-place Basis*

Measurement of aggregate base made on a cubic yard, in-place basis will be made taking depth tests or cores at the rate of one depth test for each 300 square yards of base course, or by means of average end areas on the complete work computed from elevations to the nearest 0.01-foot. On individual depth measurements, thicknesses more than ½-inch in excess of that shown shall be considered as specified thickness, plus ½-inch in computing the yardage for payment.

603.04.01C *Ton Basis*

Measurement made on a ton basis will be for the number of tons of aggregate base as weighed on approved and tested scales. Give scale tickets to the Inspector for his signature as the material is delivered. Each ticket shall show the date and time of delivery, truck number, driver's name, and net weight of material and will be considered as valid delivery receipts only when signed by the Inspector. Deductions in weight will be made at the point of weighing for moisture in excess of the optimum moisture content determined for the material being supplied.

603.04.02 *Payment*

Payment will be made on square yard, cubic yard, or ton basis as shown on the Contract Documents.

604 CEMENT-TREATED BASE

604.01 *DESCRIPTION*

This section covers the work necessary for the furnishing and construction of the cement treated base (CTB) complete in-place.

604.02 *MATERIALS*

Composition of Mixture

The CTB mixture shall be comprised of aggregate, portland cement, and water in the proportions and amounts established by the mix design. The cement content normally is to be between 4.5% and 5.5% of the dry weight of the aggregate. The mixture shall be proportioned to provide for a minimum 28-day ultimate compressive strength of 1,000psi. The proportions of the materials will be subject to change as required to meet the herein specifications.

In all plants the weight or rates of feed of aggregates and water shall be within 5% of the amounts of each material that is specified. The weights or rates of feed of cement shall be such that the variations in cement content in samples taken from any part of a mixed batch, or from different batches, or from time to time from the product of

continuous mixers, or from mixtures spread on the roadbed shall not have variations above or below the cement content designated by the Engineer of Record of more than 0.5 of a percentage point.

604.02.01 *Aggregate*

The aggregate shall meet the requirements of *Section 603* and shall be crushed rock or gravel, including sand conforming to specifications.

604.02.02 *Portland Cement*

Cement to be used shall be portland cement Type I or Type II conforming to the requirements of AASHTO M-85 for low alkali cement. The total alkali content shall not exceed 0.8% and the tricalcium aluminate content shall not exceed 10%.

604.02.03 *Water*

Conform to the requirements in *Subsection 205.02.03*.

604.02.04 *Asphalt Materials*

Conform to the requirements of *Subsection 205.02.10*.

604.02.05 *Mix Design and Certification*

Ten days prior to production, the Contractor shall furnish the Project Manager a complete mix design showing the proportions of all constituents proposed for use, and strength test results of samples prepared using the proposed proportions and constituents for a minimum of 7-day, 14-day, and 28-day curing periods. Also accompanying the mix design, the Contractor shall submit the manufacturer's certification and a copy of test results with respect to the product involved. The certification shall consist of the name of the project, the name and address of the manufacturer, and the testing agency and the date of testing. The certification shall also set forth a means of identification that will permit field determination of the product delivered to the project as being the product covered by the certification.

The Contractor shall be responsible for all costs of certification and testing of products in connection therewith.

604.03 *CONSTRUCTION*

Preparation of Underlying Course

Prior to the production or placing of CTB, complete all utility work and prepare the subgrade in strict accordance with *Section 601*.

604.03.01 *Mixture*

The CTB mixture shall be mixed at a centrally located plant of the batch type or of the continuous mixing type, capable of providing a mix of aggregate, cement, and water of uniform proportions and consistency as designated by the mix design.

The charging of the materials into the mixer shall be by means whereby the quantities of the several materials are accurately controlled. Mixing shall continue until a uniform and homogeneous mixture of aggregate, cement, and water has been obtained. In general, the time of mixing shall not be less than 30-seconds, except that the time may be reduced when tests indicate that the requirement for the variation of cement content as specified can be consistently complied with.

604.03.02 *Weather Limitations*

The CTB shall be constructed in accordance with the weather limitations as set forth in *Section 208*.

604.03.03 *Equipment*

Equipment used shall conform to the following requirements unless otherwise approved by the Engineer.

604.03.03A *Hauling Equipment*

Vehicles for hauling the mixture shall be watertight, agitating or non-agitating, and capable of discharging the mix without waste and with practicable minimum amount of separation.

604.03.03B *Spreading Equipment*

Spreading of the CTB mixture shall be by a machine that has an adjustable screed or strike-off assembly, and it may have a receiving and distribution system. The equipment shall be capable of spreading the material and striking it off to the required thickness and the designated line, grade, and transverse slope without segregation, dragging, or fracture of material. The spreading and screeding equipment may be a complete and integral self-propelled and powered unit; a crawler-track or wheeled-type tractor intimately combined with a receiving, spreading, and screeding unit attached thereto; or, if approved by the Engineer, a heavy-duty, self-propelled grader equipped with at least an 8-foot blade. The screed or strike-off assembly shall operate by an approved action that produces specified results and a surface texture of uniform appearance.

Spreading equipment that rides on freshly spread material and produces tracks or partially compacted areas thereon will be acceptable provided no displacement of material or filling of tracks occur, and provided further that the tracks are not of such depth as to be visible after compaction is completed.

If the Contractor so elects, the spreading equipment may be provided with a control system automatically controlling the laying of the mix to specified transverse slope and longitudinal grade by means of actuation from an independent line and grade control reference.

604.03.03C *Other Equipment*

Equipment shall be provided to apply water by spray method to the CTB mixture during its compaction, the spray attachments being of a type that will produce a uniform and controlled, fine spray. Equipment for application of the bituminous curing seal shall provide application by pressure spray method in a uniform and controlled application. Motor graders shall be available for correction of unavoidable segregation at edges of the mix.

604.03.03D *Compacting Equipment*

Compaction shall be with vibrating type, pneumatic tire type, steel wheel type, or other approved type compactor, as the Contractor may elect; provided, however, that compactors with lugs, projections, or other features that would leave ruts, holes, grooves, or uneven surfaces in the CTB after compaction or that would loosen the mixture while operating will not be permitted. Either a pneumatic tire roller or a smooth steel wheel roller shall be provided for the final rolling and compacting of the mixture.

604.03.04 *Hauling and Placing*

Maintain the surface of the underlying course in a wet condition by sprinkling just in advance of placing. The CTB mixture shall be delivered and deposited without delay. Mixture that has begun to harden and take an initial set prior to placement, or that has been re-tempered in transit with water, will be rejected and shall be wasted at the sole expense of the Contractor.

The mixture shall be delivered to the spreading machine by direct deposit in the receiving hopper, by placing in windrows in front of the machine, or by other means acceptable to the Engineer. If material is

placed in windrows, it shall be deposited on the roadbed at a uniform quantity per lineal foot; quantity shall be sufficient to provide the required compacted thickness without resorting to excess spotting, picking-up, or otherwise shifting of the mixture. The mixture shall be delivered and placed without hauling equipment operating over any uncured material.

The mixture shall be spread and screeded by specified equipment in one or more layers to provide the compacted thickness called for by the Standard Details. Placing shall be in strip widths that will hold the number of longitudinal joints to a practicable minimum, normally to a minimum of 10-foot widths.

The depositing and spreading shall progress continuously without breaks insofar as is practicable. Should stoppage of operations be of such duration as to allow the mixture to take its initial set, the Contractor shall construct a transverse construction joint as hereinafter provided.

The mixture shall be spread and screeded to required thickness and to designated line, grade, and transverse slope without segregation, dragging, or fracture of the components of the mixture.

Motor graders shall be used to correct unavoidable segregation at edges and to reprocess minor areas of deficiency.

604.03.05 *Thickness and Number of Layers*

If the required compacted depth of CTB exceeds 6-inches, it shall be constructed in 2 or more layers of approximate equal thickness. The maximum compacted thickness of any one-layer shall not exceed 6-inches.

604.03.06 *Construction Joints*

When it is necessary, due to the termination of the day's run or to shutdown, to discontinue placing the mixture for a period of time, which will allow the placed mixture to take its initial set, the Contractor shall construct a temporary transverse construction joint. This joint shall be formed with a wooden block, such as a 6-inch thick timber with width equal to or greater than the depth of the course, or with other devices acceptable to the Engineer, extending across the width of the strip and held firmly against the vertical end of the strip of mixture that is to terminate at the joint. The top of the joint form shall be set true to the slope and grade of the CTB and shall be firm under pressure from compacting equipment. When construction of the CTB is resumed, the form shall be removed without damage to the adjacent CTB.

604.03.07 *Compaction*

Compaction of the CTB mixture with specified compactors shall begin as soon as it has been spread and shall be continuous until completion. Not more than 60-minutes shall elapse between the start of the mixing and the time of starting compaction of the CTB mixture on the prepared subgrade. Compaction shall begin at edges and shall be controlled to prevent breakdown at the sides of a strip.

Successive passes of the compactor shall be so spaced that no more than 75% of the compactive width of the compactor shall be on an uncompacted area at any time.

During compacting, sprinkling with water by fine spray application shall be done at the time and in the amounts required. Surfaces of uncompacted, partially-compacted mixture shall be kept moist at all times until the bituminous seal has been placed thereon.

Compaction on the completed CTB shall be 95% of the maximum density indicated by the mix design.

604.03.08 *Surface Finish*

The CTB surface shall parallel the cross section and grade of the finished surface within 0.04-foot and, when tested with a 10-foot straight edge, shall not vary from the testing edge by more than 0.04-foot at any point.

When portland cement concrete (PCC) pavement is to be placed on the CTB, the surface of the CTB at any point shall not extend above the grade established by the Engineer of Record. The specified finish shall be attained by the following method.

After compaction of the final lift, the surface of the CTB shall be brought within the specified tolerances by trimming with a subgrade planner, by motor grader equipped with an electronically controlled blade, or by grinding. Areas on which trimming or grinding is performed shall be rolled until a smooth surface is attained.

The excess material may be used at other locations in the work area provided said excess material complies with applicable specification requirements.

604.03.09 *Bituminous Curing Seal*

As soon as possible after each layer of the CTB is constructed as hereinbefore specified and while it is still moist, the surface and exposed edges shall be covered with a bituminous curing seal. The liquefied asphalt shall be applied by a pressure spray method at a uniform rate between .25 gallon and .35 gallon per square yard.

After the curing seal has been applied it shall cure for a period of 4-days and, during this period, no vehicle shall be permitted to use the section. In case of damage to the curing seal after application and during the curing period, the damaged section shall be repaired by resealing at the Contractor's sole expense.

The curing seal on any lift of CTB may be omitted if, within 2-hours after the start of mixing of the preceding lift of CTB, a succeeding lift of material (CTB, bituminous base, or asphalt concrete) is placed over the preceding lift. Vibratory rollers will not be permitted in the compaction of any succeeding lift of CTB, bituminous base, or asphalt concrete during the period of time from 2-hours to 96-hours after the mixing of any of the underlying lifts of CTB.

604.03.10 *Care of Work*

During the construction of the CTB, the Contractor shall exercise care to protect the work from damage. Following construction of each strip and each layer of the base and following construction of the entire course of the CTB, the Contractor shall perform such work as specified and as the Engineer may determine to be necessary to prevent raveling and rutting, to prevent segregation of materials, and to maintain the layer or course of the CTB to the specified compaction and surface finish – all until the strip, layer, or course is covered by a following layer or course of material as specified or until all work under the Contract Documents is completed.

604.03.11 *Modification of Equipment and Methods*

On tapers and other areas of irregular shape, limited length, restrictive width, or other conditions where the Engineer determines that full compliance with the above equipment and construction requirements is not practicable, the specified equipment and construction requirements may be modified subject to approval by the Engineer.

604.03.12 *Timing of Operations, Adequacy of Organization, and Rejection of Mixture*

All operations involved in constructing the CTB shall be so timed and coordinated that, regardless of daily or seasonal variations in weather, temperature, or humidity, such work shall result in a finished CTB conforming in all respects to specified requirements.

In this respect, the Contractor shall provide and have readily available at all times adequate equipment, tools, material, and labor, and shall achieve the hauling, spreading, compacting, and trimming of the CTB mixture within 2-hours after mixing.

Any CTB mixture not placed and trimmed within this 2-hour period shall be subject to rejection, wasting, removal, and replacement as the Engineer determines to be applicable, and all costs involved in such removal, wasting, and replacement shall be borne by the Contractor.

604.03.13 *Handling Traffic Over Cement-treated Base*

At locations where traffic must be routed over the CTB, the CTB mixture shall be made with Type III or Type IIIA (high-early strength) cement to expedite development of strength at an early date. Any extra costs of using high-early strength cement shall be considered as incidental with payment, therefore, covered in the pay item "portland cement in CTB mixture."

If the Engineer so directs, traffic over recently constructed CTB shall be controlled as to speed and routing.

604.03.14 *Testing*

Materials and Mixture

Aggregate and cement will be subject to acceptance as specified under **Section 205**. Plant mixed mixtures will be subject to final acceptance after blending and mixing either at the plant or place of delivery. Acceptance will be based on periodic sample taking.

When specified the Contractor shall furnish certified laboratory tests that show results of the tests at no expense to the City. The Engineer may do sampling and/or testing of the materials at the sole expense of the Contractor. If evidence of non-compliance with the requirements exists, additional tests may be required to assure that the materials meet the requirements as specified

604.03.14A *In-place Sample*

The Engineer shall be permitted to cut samples or take cores, or to require the Contractor to cut samples or take cores, from the full depth of the compacted mixture or from the separate layers and courses thereof for testing purposes and at such locations and at such frequencies as the Engineer determines necessary for proper representation. Sampling shall be at the expense of the Contractor. Where samples have been taken and where the samples show deficiencies according to these specifications, the Contractor shall repair the cuts or cores with like material and shall make repairs to the pavement as directed by the Engineer all at not expense to the City.

604.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

604.04.01 *Cement Treated Base*

Quantities for CTB will be measured on a square yard basis. The measurement will be based on the surface length and width up to the specified length and width of the CTB measured to the nearest 0.1-foot and the area measured to the nearest square yard.

604.04.02 *Bituminous Curing Seal*

The asphalt emulsion used for the bituminous curing seal shall be measured on a square yard basis, and shall include only that asphalt emulsion actually incorporated in the seal.

604.04.03 *Payment*

Payment for the CTB and asphalt curing seal shall be based on the price stated in the Contractor's Proposal and shall be understood to comprise full and complete compensation for all labor, equipment, tools, materials, and incidentals necessary for all of the contract work as specified under or covered by this section.

When neither specified nor listed in the Contract Documents for separate payment, any and all work specified for performance under or covered by this section will be considered as incidental work for which no separate payment will be made.

605 ASPHALT CONCRETE PAVEMENT

605.01 DESCRIPTION

This section covers work necessary for the construction of hot mix asphalt pavements under prepared foundations or base surfaces. Hot mix asphalt concrete is defined as a mixture of asphalt cement, high quality aggregate well graded, mineral filler and additives as required, heated and plant mixed into a uniformly coated mass; hot laid on a prepared foundation and compacted to specified density.

605.02 MATERIALS

605.02.01 General

Asphalt and aggregate shall meet OSHD requirements for light-duty AC and will be subject to approval preceding mixing. Plant mixed mixtures will be subject to final approval after blending and mixing, either at the plant or at the place of delivery, prior to rolling. Approval will be based on periodic sampling and testing of the materials.

605.02.02 Asphalt Cement

Asphalt materials incorporated in the mix shall be performance graded (PG) 64-22 that conforms to the requirements of **Subsection 205.02.11B**.

605.02.03 Aggregates

Aggregates shall conform to requirements of **Section 205**.

605.02.04 Mineral Filler

Mineral filler shall conform to the requirements of AASHTO M-17.

Collector dust may be used as mineral filler, in whole or in part, provided the dust or the resultant mineral filler mixture conforms to the above requirements.

605.02.05 Additives

Additives may be used to prevent stripping or separation of asphalt coatings from aggregates, and admixtures may be used to aid in the mixing or use of asphalt mixes. Use admixtures and additives of standard, recognized products of known value for the intended purpose, and obtain approval on the basis of laboratory tests prior to their use. They shall have no deleterious effect on the bituminous material and shall be complete miscible. Do not use silicones as an additive.

605.02.06 Composition and Proportion of Mixtures

The class of asphalt concrete to be used shall be as shown and shall conform to the following requirements. Table ranges are inclusive of tolerances.

Sieve Size Passing	DENSE GRADED		
	Percentage of Total Aggregate (by weight)		
	¾" Dense	½" Dense	⅜" Dense
1"	99 – 100	---	---
¾"	90 – 100	100	---
½"	0 – 90	90 – 100	0 – 100
#4	---	---	0 – 90
#8	12 – 49	28 – 58	32 – 67
#200	2.0 – 8.0	2.0 – 10.0	2.0 – 10.0
Asphalt Cement*	4 – 8	3 – 8	4 – 8
*Percent of total mix (by weight).			

Asphalt cement to be added to the recycled mixture will vary from 3% to 8%. Class "B", "C", and "D" asphalt concrete shall meet the following qualifying test requirements:

Test	Test Method	Requirements
Stability, first compaction	ODOT standard test*	35 min. (residential streets) 40 min. (arterial streets)
Voids, first compaction	ODOT standard test*	7% max.
Voids, second compaction	ODOT standard test*	1% min.
Retained strength	AASHTO T-165 Modified	70% min.
*Available from ODOT's Pavement Services Engineer in Salem, Oregon		

605.02.07 Mix Formulas

The Contractor may be required to submit a job-mix formula for review by the Engineer.

Job mix formulas shall meet the requirements of ODOT Level 2 mix, except that on arterials and collectors the Engineer may require that a formula meeting ODOT Level 3 mix be used.

	Level 2	Level 3
Design Method	75 Gyration	75 Gyration
Air Voids, percent	4.0	Base: 4.0 Wearing: 4.0 – 4.5
VMA, percent minimum	¾" – 13.0 ½" – 14.0 ⅜" – 15.0	¾" – 13.0 ½" – 14.0 ⅜" – 15.0
P #200/Eff AC ratio	0.8 to 1.6	0.8 to 1.6
TSR, percent minimum	80	80
VFA, percent	65 – 78	65 – 75

The job-mix formula shall indicate the gradation of each of the several aggregate constituents to be used in the mixture and shall establish the exact proportion of each constituent to be used to produce a combined gradation of aggregate within the appropriate limits stated above.

The job-mix formula shall also indicate: ASTM bulk specific gravity of each aggregate constituent; the measured maximum specific gravity of the mix at the optimum asphalt content determined in accordance with ASTM D-2041; all properties as stated in **Subsection 605.02.06** of these specifications for at least 4 different asphalt contents other than optimum, 2 of which will be below optimum and 2 of which will be above optimum; the percent of asphalt lost due to absorption by the aggregate; and any other information pertinent to the design of the mix.

605.02.08 Recycled Asphalt Pavement (RAP) Materials Permitted

The Contractor shall have the option of using processed recycled asphalt pavement materials in the production of new asphalt concrete pavement. The RAP materials proposed for use in the recycled mix shall contain hard, sound, and durable aggregates and asphalt of a composition to provide properties equivalent to asphalt as specified in these specifications when in the mix. Recycled material that is used in the asphalt concrete pavement shall be no larger than the specified maximum allowable aggregate size prior to entering the cold feed. If there is evidence of the recycled material not breaking down during the heating and mixing of the asphalt concrete mixture, the Engineer may elect to modify the maximum size requirement. Not more than 20% by weight of recycled materials may be used in the mix.

605.02.09 Tolerances

After the mix formula is submitted, the several constituents shall meet the following tolerances, but always within the range of proportions specified in **Subsection 607.02.06**:

Asphalt Concrete Mix Tolerances	
Tolerance (\pm to job mix formula)	
	Specifications
Aggregate passing 1", ¾", ½" sieves	0%
Aggregate passing ¼" sieve	5%
Aggregate passing No. 10 & No. 40 sieve	4%
Aggregate passing No. 200 sieve	2.0%
Asphalt cement	0.5%

Each day the Engineer shall be permitted to take as many samples as he considers necessary for checking the uniformity of the mixture. When unsatisfactory results or other conditions make it necessary, the Engineer may require a new mix formula.

Should a change in source of material be made or should conditions arise that the Engineer determines to be justified, the Contractor shall establish a new job-mix formula.

The materials to be used in the work shall be of such nature that a mixture of them, proportioned in accordance with the mix formula, will have a retained strength of no less than 70% when tested in accordance with AASHTO T-165 as modified by ODOT test methods. The Engineer shall be permitted to take as many samples as he considers necessary for checking the uniformity of the mixture.

605.02.10 Feathering

Asphalt concrete for use in feathering at curb or gutter lines, at intersections, at connections with existing pavement, in spot patching, and under similar conditions shall be a fine mix of asphalt concrete such as ¾" mix. Wedge cutting or grinding shall be used when connecting local streets to neighborhood collectors and higher classifications of streets.

605.03 CONSTRUCTION

605.03.01 Pre-paving Conference

The Contractor and his supervisory personnel, plus any subcontractors and their supervisory personnel, who are to be involved in the paving work shall meet with the Project Manager and his representatives for a pre-paving conference at a time mutually agreed upon. At this conference, the Contractor shall discuss his methods of accomplishing all phases of the paving work. The plan of the work, order of paving, and other details of performance shall meet with the approval of the Project Manager.

605.03.02 Preparation of Bases

All pavement bases and foundations constructed under these Contract Documents shall be completed and finished as prescribed under the applicable specification for its construction.

Manholes, inlets, water valve boxes, and other such structures shall have been completed, cured, and otherwise prepared as applicable and made clean and ready for asphalt pavement. Unless otherwise approved, manholes shall be adjusted to designed finish grade prior to paving. If otherwise approved, manholes will be adjusted to finished grade after paving according to the Standard Details. Paint vertical surfaces that will come in contact with asphalt pavement with tack coat material to provide a good bond and seal. Cover top surfaces with paper or other material to prevent adherence of asphalt pavement, tack coat, or prime coat.

605.03.03 Reconditioning Old Roadbed

This work consists of reconditioning and preparing previously constructed roadbed subgrades, existing stone bases and surfacings, and existing pavements; none of which were constructed by the Contractor under the pertinent Contract, but on which an additional layer or course of material is to be placed.

Existing aggregate subbases, bases, and surfacings shall be bladed, scarified, leveled, and compacted in conformance to lines, grades, and cross sections as established and the density and tolerance requirements of *Section 603*.

Pre-level uneven or broken asphalt, cement concrete, or brick surfaces with asphaltic concrete as specified. Spread and compact pre-leveling asphaltic concrete to the density and surface condition as directed.

605.03.04 Tack Coat

Asphalt shall consist of emulsified asphalts (CSS-1 or CSS-1h) or an approved equal.

Spread asphalt by means of pressure-spray equipment that will provide uniformity of application at prescribed rates. Do not apply aggregate cover material to the tack coat. Asphalt shall be applied to the prepared surface at a residual rate of 0.04 to 0.08 gallons per square yard. The tack coat shall not be applied during wet or cold weather or during darkness; apply only so far in advance as is appropriate to maintain a tacky, sticky condition of the asphalt. Apply tack coat in such a manner as to offer the least interference to traffic and to permit at least one-way traffic without pickup or tracking of asphalt.

Tack coat all edges of existing pavement and manholes and clean out frames, inlet boxes, and like items. Tack the lift of pavement when traffic has been allowed on it prior to subsequent lifts.

605.03.05 Mixing

Mix the asphalt concrete by combining aggregate, asphalt, and additives at an approved central mixing plant equipped with controls to accurately measure and monitor the various components of the mix to produce a uniform, homogeneous mixture at the specified temperature.

The discharge temperature of the mix will vary with the type of mixing plant, climatic conditions, and other variables. However, the temperature shall be sufficient to provide thorough mixing and coating and to provide a mass viscosity of the mix on the grade that will permit compaction to required density. Mix temperatures and asphalt in storage shall generally not exceed 340° F.

605.03.06 *Placing*

Conform to the Contract Documents for order of paving, lift thickness, and other requirements of performance as approved.

Transport the asphalt concrete mixture from the mixing plant to the point of use in trucks. Send no loads so late in the day as to prevent the spreading and compacting of the mixture during daylight, unless approved lighting is provided. The temperature of hot mix at the time it is spread into final position shall be between 240° F and 302° F.

When the capacity of the paver to properly spread and finish exceeds the rate of delivery of mixture, operate the paver at a reduced and uniform speed to give continuous spreading and finishing.

Take care at all times to prevent segregation in the mixture as evidenced by areas of fine and coarse materials, and correct any such segregation with fresh mixture either spread and worked into the surface or by complete removal and replacement of segregated mixture as deemed appropriate by the Inspector. This work shall be done at no expense to the City. At no time shall the coarse aggregate segregated from the mix from hand spreading or raking of joints be scattered across the paved mat. Such material shall be collected and disposed of.

On areas to be patched with asphalt concrete mixture and on areas of irregular shape or limited size, the spreading and finishing requirements may be modified as approved by the Project Manager.

Boils and slicks occurring in the pavement must be immediately removed and replaced with suitable materials at the sole expense of the Contractor.

605.03.07 *Protection of Structures*

Protection of structures must conform to ***Subsection 210.03.04F***.

605.03.08 *Paving Plant Equipment*

All plant and equipment used by the Contractor in the preparation and mixing of asphalt concrete shall conform to the requirements of the latest edition of ODOT/APWA Oregon Standard Specifications for Construction.

605.03.09 *Weigh Scales*

When materials are to be measured for payment by weighing on vehicle scales, the Contractor shall provide the scales and transport the materials to the scales provided.

The vehicle scales furnished shall be accurate within the tolerances required by state law and shall be licensed with the Oregon Department of Agriculture. Scales shall be suitable for the weighing to be done and shall be properly installed and maintained.

At each end of the vehicle scale there shall be a straight approach in the same plane as the platform. The approaches shall be of sufficient length and width to ensure the level positioning of combination vehicles longer than the scale platform during weight determinations. All vehicle brakes shall be released while combination vehicle are being weighed.

Vehicle scales shall be inspected and the accuracy tested every 6 months by either the State Department of Agriculture or a scale service company. Scales installed at a new site shall be inspected and the

accuracy tested before use. Testing by a scale service company shall be done by using a minimum of 10,000 pounds of test weights certified by the State Department of Agriculture.

605.03.010 Hauling Equipment

Vehicles used for hauling asphalt concrete mixtures shall have tight, clean, and smooth beds that have been thinly coated with a minimum amount of paraffin oil, lime solution, soapy water or other approved release agent to prevent the mixture from adhering to the beds.

During each application of an approved coating material and prior to loading, the vehicle bed shall be drained of all excess coating material by raising the truck bed, opening belly dump gates, or operating the conveyer belt as appropriate for the type of equipment being used.

Vehicles that cause excessive segregation, that leak badly, or that delay normal operations as such are determined by the Engineer shall not be used.

Contractor's hauling vehicles shall be constructed and equipped with covers to protect against moisture and against heat loss, and shall have a 3/8-inch diameter hole near the middle of the left sidewall of the bed to allow access for a thermometer.

605.03.11 Asphalt Concrete Pavers

Pavers shall be self-contained, power-propelled units provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of asphalt concrete material in lane widths applicable to the specified typical sections and to required thicknesses, lines, grades and cross sections.

Extensions added to the paver when used on travel lanes shall have the same auguring and screeding equipment as the rest of the paver.

The paver shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation, and be capable of placing the mixture uniformly in front of the screed without segregation of materials.

The paver shall be designed to compensate for minor irregularities of the base on which it is supported so that such will not be reflected immediately in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels, none of which shall contact the mixture being laid. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the strip of mixture being placed.

The screed or strike-off assembly shall produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. The paver shall be equipped with either a manual or electronic line and grade control.

605.03.12 Weather Limitations

Asphalt concrete mixtures shall be placed on dry prepared surfaces when the air temperature in the shade and the surface temperature is not less than those specified in the following table:

SURFACE TEMPERATURE LIMITATIONS		
Compacted Thickness of Individual Courses:	Travel Lanes/Wearing Course	All Other Courses
Less than 1½ inches	60° F	55° F
1½ inches to 2½ inches	50° F	45° F
Over 2½ inches and other	40° F	35° F

Placing of any mixture during rain or other adverse weather conditions normally will not be permitted except that mix in transit at the time these adverse conditions occur may be laid if of proper temperature, if the mix has been covered during transit, if placed on a foundation free of pools or flow of water, and if all other requirements of these specifications are met. Asphalt concrete mixtures shall not be placed when the underlying layer is frozen or when, in the opinion of the Engineer, weather conditions either existing or expected will prevent the proper handling, finishing, or compaction of the mixtures.

605.03.13 *Compaction*

The Contractor will not be permitted to use any equipment that crushes the aggregate to any extent. However, the Contractor will be required to obtain the densities required in **Subsection 605.03.15**.

605.03.14 *Compactors*

Rollers shall be steel wheel, pneumatic tire, vibratory, or a combination of these types as the Contractor may elect. They shall be in good condition and capable of reversing without backlash.

605.03.14A *Steel Wheel Rollers*

Steel wheel rollers shall have a minimum gross static weight of 8 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width. For finish rolling a 6-ton minimum gross static weight is acceptable and the 250 pounds per inch of width will not be required.

605.03.14B *Vibratory Rollers*

Vibratory rollers shall be equipped with amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixtures. The rollers shall be capable of frequencies of not less than 2,000 vibrations per minute and a static weight of 8 tons.

605.03.14C *Pneumatic Rollers*

The pneumatic-tired rollers shall be self-propelled, tandem, or multiple axle, multiple wheel type with smooth-tread pneumatic tires of equal size staggered on the axles at such spacings and overlaps as will provide uniform compacting pressure for the full compacting width of the roller, and shall be capable of exerting ground pressures of at least 800 pounds per square inch of tire contact area. Pneumatic-tired rollers shall be fully skirted to insulate the tires from significant heat loss during compaction.

605.03.15 *Density Requirements*

The density of asphaltic concrete shall be at least 91% of Rice theoretical maximum density as determined in conformance with AASHTO T-209.

Asphaltic concrete pavements that do not meet the requirements for compaction and are deemed by the Engineer to be not suitable for use will be rejected and removed at no cost to the City.

Asphaltic concrete pavements that do not meet the requirements for compaction but are deemed by the Engineer to be suitable for use may be left in place if the Contractor so elects.

Samples and tests will be taken as frequently and at such locations as the Engineer elects, and the results will be made known to the Contractor as soon as practical. However, it shall be the responsibility of the Contractor to obtain specified density at all times and delay in advising the Contractor of test results shall not act as a waiver of this responsibility. When it is determined that specified density is not being obtained, discontinue all paving operations until corrective measures have been taken.

Any displacement occurring as a result of the reversing of the direction of a roller or from other causes shall be corrected at once by the use of rakes and addition to fresh mixture when required. Do not

displace the line and grade of edges. Moisten steel roller wheels with water or other approved material to the least extent necessary to prevent pickup of mixture and yet not cause spotting or defacement of the surface of the mixture.

Along curbs and walls, on walks, irregular areas, and other areas not practicably accessible to specified rollers, compact the mixture with small rollers, mechanical tampers, hot hand tampers, or smoothing irons. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area. Top lift of AC shall be minimum of 1.5-feet in width, mechanically compacted such that no bridging of work area by compacting equipment occurs.

Remove and replace any mixture that becomes loose and broken, mixed with dirt, or is defective in any way. Remove and replace any area showing an excess or deficiency of bituminous cement. Removal and replacement under these provisions shall be at the sole expense of the Contractor.

605.03.16 *Transverse Joints*

Form transverse joints by cutting back on the previous run to expose the full depth of the layer or course.

Place a course or strip of asphalt concrete as nearly continuous as practicable. Carefully construct transverse joints using vertical faces and thoroughly compacted to provide a smooth riding surface. Apply a coat of bituminous material to contact surfaces just before mixture is placed against previously rolled mixture. The Contractor shall use a 12-foot straight edge to determine the location of the full depth vertical faces.

At bridge ends or at joints with other rigid type structures, existing bases shall be conditioned and compacted and place asphalt concrete to extra thickness and compact in transverse direction as well as longitudinally.

When the end of a course or strip of asphalt concrete is to be temporarily subject to traffic, the end shall be left on a bevel of approximately 20:1 (horizontal to vertical) being later cut back to a vertical edge.

605.03.17 *Longitudinal Joints*

Before any paving is started the Contractor shall submit to the Project Manager for review a drawing indicating locations of longitudinal joints.

The mixture shall be laid in strips of such widths as to hold to a practical minimum the number of longitudinal joints required. Longitudinal joints in the wearing course shall not occur within the area or width of a traffic lane or auxiliary lane. On median lanes and on shoulder areas such joints shall occur only at points of change in the transverse slopes as shown on the plans or designated by the Engineer. The longitudinal joints in one layer shall offset those in the layer immediately below by a minimum of 6-inches. Underlying longitudinal joints shall be within 12-inches of the edge of a lane or within 12-inches of the center of a lane, except in irregular areas or if otherwise shown on the plans. Joints shall not be located in wheel paths.

When the end of a course or strip of asphalt concrete is to be temporarily subjected to traffic, the end shall be on a bevel of approximately 20:1 (horizontal to vertical). Install paper joint, grind, or cut back to a vertical edge to provide a fresh surface against which subsequently placed asphalt concrete is to abut.

When placing of asphalt concrete pavement in layers in excess of 2-inch nominal thickness is being performed under traffic, work shall be scheduled in a manner such that at the end of each working day the full width of the area to be paved shall be completed to the same elevation with no longitudinal drop-offs within this width.

When placing of asphalt concrete pavement in layers of 2-inches or less in thickness is being performed under traffic, work shall be scheduled in a manner such that at the end of each working shift one strip of new travel lane pavement shall not extend ahead of the adjoining strip of travel lane pavement more than the distance normally covered by each shift.

Where abrupt or sloped drop-offs occur at the edge of the paved surface, the Contractor shall construct and maintain a wedge of asphalt concrete at a Slope 10:1 or flatter along the exposed joint.

605.03.18 *Thickness and Number of Layers*

Asphalt concrete shall be placed in the number of courses and to the total compacted thickness per course called for by the typical cross sections given on the plans or the minimum section shown in the standard details, whichever is greater.

In case the course of pavement involves the placing of a layer of variable thickness as for leveling existing irregular surfacings, the course may include or consist of a layer of asphalt concrete of variable compacted thickness, the thickness of which layer shall not exceed the following:

Type of Mix	Compacted Thickness Layers	
	Minimum	Maximum
¾"	3-inches	3-inches
½"	2-inches	3-inches
⅜"	1-inch	2-inches

The top surface of each layer of asphalt concrete shall be spread at grade and cross section closely paralleling the specified top surface of the finished pavement.

605.03.19 *Pavement Samples*

The Engineer shall be permitted to cut samples or to take cores from the full depth of compacted mixture or from the separate layers and courses thereof for testing purposes, and at such locations and at such frequencies as the Engineer determines necessary for proper representation. Where samples have been taken and when directed by the Engineer, the Contractor shall furnish new like material for filling the holes at no cost to the City.

605.03.20 *Pavement Smoothness*

The top surface of the asphalt concrete pavement, when tested with a 12-foot straightedge furnished by the Contractor, shall not vary by more than 0.02-foot either parallel to or perpendicular to the centerline. The Inspector will observe this testing and may require additional testing. The means of correction of a surface that does not meet the smoothness requirements shall have the approval of the Engineer.

When tests show the pavement is not within the above tolerances, the Contractor shall take immediate action to correct equipment or procedures in his paving operation to eliminate the unacceptable pavement roughness.

Any surface irregularities exceeding the above tolerances shall be corrected by the Contractor using a method or methods listed herein and approved by the Engineer.

Corrective Action – Corrective measures by the Contractor requiring one or more of the following actions approved by the Engineer shall be performed on deficient areas:

1. Remove and replace the surface course.
2. Place an overlay of a thickness approved by the Engineer.
3. Grind the pavement surface utilizing diamond blades up to a maximum depth of 0.3-inch and apply an emulsion fog coat as directed by the Engineer.

Unless otherwise directed, all corrective work shall be completed within 10 working days following notification from the City that the pavement does not meet the specified tolerances.

All corrective work, including furnishing of materials, shall be performed at no expense to the City. On publicly financed improvement projects, no adjustment in contract time will be made for corrective action work.

605.03.21 *Special Protection Under Traffic*

In addition to other required provisions for traffic, the following shall apply to pavement construction: No traffic or equipment shall come in contact with the compacted mixture until it has cooled and set sufficiently to prevent marking; edges shall be protected from being broken down; and edge drop-offs one or more inches in height shall be marked with warning devices visible by day and night to the traveling public and placed at spacings indicated on the plans or as directed by the Engineer.

605.04 *MEASUREMENT AND PAYMENT (Not applicable to publicly financed public improvements)*

605.04.01 *Measurement*

Pay quantities for hot mix asphalt concrete and other asphalt construction under this section will be measured by one or another of the methods as set forth hereinafter.

605.04.01A *Asphalt Concrete on Ton Basis*

When pay items in the Contract Documents so indicate, the quantity of asphalt concrete used in the accepted work as specified will be measured on a ton basis. There will be no separate measurement of bituminous cement or additives contained in the mixture or used otherwise in the work. Measurement will be made on the number of tons of asphalt concrete as weighed on approved and tested scales. Give trip tickets to the Engineer for his signature as the material is delivered. Each trip ticket shall show date and time of delivery, truck number, driver's name, and net weight of material and will be considered as valid delivery receipts only when signed by the Inspector. No material will be accepted or paid for without a trip ticket being available at the time of delivery.

When the pavement is found deficient in thickness by more than 0.2-inch but not more than 1-inch as determined by test cores of reasonable test samplings, payment for pavement will be made adjusting the unit price downward 4% for each tenth of an inch below the specified depth. Pavement found deficient in thickness by 1-inch or more will not be accepted or paid for.

For publicly financed improvement projects, a price reduction for such materials will be determined as follows: The percentage below the required density will be squared and then rounded off to the nearest whole figure and a percentage deduction made to the in-place price equal to the results. Any pavement with a density less than 89% will not be considered suitable.

605.04.01B *Asphalt Concrete on Square Yard Basis*

When the pay items in the Contract Documents so indicate, asphalt concrete complete in-place as specified and accepted will be measured on a square yard basis. Measurement will be made of width and length of each separately constructed strip of pavement wherein width is the design width or edge-to-edge width of pavement, whichever is the lesser, and length is from end to end of the pavement along the center of the strip. Measurement will be on the surface of the pavement to the nearest 0.1-foot and the square yardage will be to the nearest full square yard.

The Engineer may take core samples of the pavement or use other methods to determine the actual pavement thickness constructed. Extra thickness of pavement as shown or as directed will be measured by conversion on a proportionate volume basis to an equivalent number of square yards of specified standard thickness pavement.

No additional payment over the Contract Documents unit price will be made for pavement having a thickness greater than shown or directed. When the pavement is found deficient in thickness by more than 0.2-inch but not more than 1-inch as determined by test cores of reasonable test samplings,

payment for pavement will be made adjusting the unit price downward 4% for each tenth of an inch below the specified depth. Pavement found deficient in thickness by 1-inch or more will not be accepted or paid for.

For publicly financed improvement projects, a price reduction for such materials will be determined as follows: The percentage below the required density will be squared and then rounded off to the nearest whole figure and a percentage deduction made to the in-place price equal to the results. Any pavement with a density less than 89% will not be considered suitable.

605.04.02 *Payment*

Payment will be made for any or all of the following items when listed as pay items in the Contract Documents for any particular contract:

	Payment Item	Unit of Measure
1.	Asphalt concrete mixture (specify class)	Per Ton
2.	Asphalt concrete (specify class & thickness)	Per Square Yard

A deduction of 1% of the in-place price will be made for each 1% cumulative deviation from the allowable tolerance of each component of the job mix formula required by the specification, except as follows:

Deviations in asphalt cement shall be weighted 8 times; deviations in #200-minus material shall be weighted 2 times the deviation in other specified aggregate sieve sizes.

All materials furnished where the cumulative deviation equals or exceeds 12% shall be removed and replaced with acceptable material at the sole expense of the Contractor.

When asphalt paving materials with a cumulative deviation of less than 12% are furnished, the City shall notify the Contractor, in writing, to remove and replace defective materials at the sole expense of the Contractor or to pay to the City liquidated damages in accordance with the above deduction schedule.

606 PORTLAND CEMENT CONCRETE PAVEMENT

606.01 *DESCRIPTION*

This section covers work necessary for construction of portland cement concrete pavements, with or without reinforcement, on a prepared subgrade or base course complete.

606.02 *MATERIALS*

All material shall conform to requirements of *Section 205*.

606.03 *CONSTRUCTION*

606.03.01 *General*

The plant, equipment, and tools required in the performance of the work must be of the design, capacity, and in condition to efficiently perform their respective functions of the work. Schedule and coordinate all operations involved in constructing the pavement so that regardless of the daily or seasonal variations in weather, temperature, and humidity under which the work is permitted to proceed, such work will result in a finished pavement conforming in all respects to specified requirements. Provide and have available at all times adequate equipment, tools, materials, and labor to achieve these results. Failure to so provide will be cause for discontinuance

or rejection of the work as determined by the Project Manager. Conform to applicable requirements of concrete construction in *Section 208*.

606.03.02 *Preparation of Concrete Mix*

Before beginning any concrete work the Contractor shall have the concrete mix designed and submit the mix design for approval. The mix design shall be tested by a laboratory approved by the Engineer and by preparing trial batches of which 4 standard test cylinders shall be cast, cured, and tested as specified for the concrete. Certified copies of all laboratory reports stating whether or not the items reported meet specifications shall be sent directly to the Project Manager from the testing laboratory.

Portland cement, fine aggregate, coarse aggregate (in required separated sizes), water, air-entraining agents, and other admixtures as required shall be used in the concrete in such proportions as may be determined to be necessary to produce a concrete of suitable workability, plasticity, and entrained-air content and of such strength as required. The proportions may be changed by the Engineer of Record during the progress of the work, but they shall at no time be such that test cylinders of the resultant concrete made in accordance with the applicable provisions of AASHTO T-23 will show compressive strengths of less than 5,000 pounds per square inch or as specified in the Contract Documents at an age of 28-days, whichever is greater.

The 28-day strength test value shall be the average compressive strength of 3 cylinders tested in accordance with AASHTO T-22. If the compressive strength of a single test specimen varies by more than 10% from the average of the other 2 specimens taken during the same pour, that compressive strength value shall be disregarded and the average compressive strength test of the 2 remaining specimens will be used. The 28-day strength test value shall not be less than the specified strength for the mix design.

Changes in proportions, and particularly in the proportion of cement, may be made not only for the purpose of causing the concrete to meet specified 28-day requirements, but also to produce concrete of high-early strength when concrete of that kind is required. The maximum amount of cement to be used shall be 750 pounds per cubic yard of concrete.

The proportions of water to be used shall be determined by the Engineer of Record, it being the intent of the specification to have the water/cement ratio held as low as is consistent with the production of a workable, uniform, and dense concrete. The maximum water/cement ratio shall be 6-gallons of water per 94 pounds of cement.

Entrained air in the concrete shall be as directed by the Engineer of Record and will be from 4% to 6% by volume. The entrained air shall be obtained by use of air-entraining cement, by air-entraining additives or admixtures, or by combinations thereof.

The Contractor shall provide and use approved means for adding controlled amounts of additives, admixtures, and retardants to the mix.

No change in the source or character of any material shall be made without due notice to the Engineer of Record and the Project Manager. No material shall be used in the mix until the Engineer of Record has approved such material and has designated the proportions of the materials in the mix based on the use of such approved materials.

606.03.03 *Hauling*

Hauling of portland cement concrete mixed at a central plant or in transit will conform to the provisions of *Section 208*.

606.03.04 *Forms*

Conform to the applicable requirements of forms in *Section 208*.

606.03.05 *Handling and Placing*

Conform to requirements for handling and placing in *Section 208*.

During the placing of concrete, make provisions for the construction of joints and the placing of dowels, tie bars, and other devices as shown.

606.03.06 *Preparation of Roadway*

Before beginning paving operations, the base constructed under the Contract Documents shall be in accordance with the applicable specification for its construction. Old base and foundations constructed under other contracts shall be brought, by the Contractor, to an acceptable condition as prescribed in these standards by the Contractor.

In addition to the base under the pavement, an area of sufficient width alongside the pavement base that will support the paving equipment shall be brought to proper grade and compacted so as to support the equipment at proper grade and cross section. The base for the pavement shall be maintained and firm and true to established grade and cross section until the concrete is placed thereon.

Manholes, inlets, and other such structures shall have been completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact therewith. Manhole frames and other independent metal structures in the pavement area shall be painted with suitable asphalt material.

The conditioned base shall be in a compacted and smooth condition when the concrete is placed thereon and shall be moist. Watering of the base shall be thorough and uniform.

The Engineer shall be permitted to place plates on prepared base and to reference them for later determination of thickness of concrete; the Contractor shall exercise care to preserve such plates from displacement.

606.03.07 *Weather Limitations*

Except with written permission from the Engineer, construction of portland cement concrete pavement shall not be in progress or continued when a descending air temperature in the shade and away from artificial heat reaches 35° F. Unless otherwise permitted, the temperature of the mix shall be not less than 50° F or more than 80° F at the time of placing. Material containing frost or lumps of hardened material shall not be used.

Concreting operations shall be discontinued if there is insufficient natural light, unless an adequate and approved artificial lighting system is provided and operated.

When concrete is being placed during cold weather and the air temperature may be expected to drop below 35° F, a sufficient supply of blankets as specified in *Subsection 208.03.09C* shall be provided along the work. Any time within 7-days of placing the concrete the air temperature may be expected to reach the freezing point, the material so provided shall be placed over the pavement to prevent freezing of the concrete. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

The Contractor shall have available at all times materials for the protection of the edges and surface of the unhardened concrete from the effects of rain or other precipitation. Protective material may consist of sheets of burlap, paper, or plastic film. It will be the Contractor's responsibility to protect the pavement from damage, and failure to properly protect unhardened concrete may constitute cause for the removal and replacement of defective pavement at no expense to the City.

606.03.08 *Slip Form Paving*

Place the concrete uniformly in final position by the slip-form method in one complete pass in such a manner that a minimum of finishing will be necessary to provide a dense and homogeneous pavement in conformance to true grade and cross section. The machine shall vibrate the concrete for the full width and depth of the pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the

concrete. The sliding forms shall be rigidly held together to prevent spreading of the forms. Use forms of sufficient length so that no appreciable slumping of the concrete will occur.

Operate the slip form paver with as nearly continuous forward movement as possible and coordinate all operations of mixing, delivery, and spreading concrete to provide uniform progress. Stopping and starting the paving machine shall be held to an absolute minimum. If, for any reason, it is necessary to stop the forward motion of the paver, stop the vibratory and tamping elements immediately. Apply no tractive force to the machine except that which is controlled from the machine. The Contractor shall stop his operation immediately if the finished work is not of specified quality. Deficient areas shall be repaired before the concrete starts to set.

Ensure that supports of the slip-form paver and other equipment that ride on previously placed pavement are offset over that pavement sufficiently to prevent breakage of the edge thereof and provide such supports with suitable protective means to avoid marring or chipping of the previously placed pavement.

Hand-spreading and distributing shall be with shovels, not rakes, and the concrete shall not be fouled with foreign matter, nor shall joint devices be disturbed during such operations. The Contractor shall furnish hand operated mechanical vibrators of a type and design approved by the Engineer. These vibrators shall be used in the consolidation of the concrete pavement within at least 6-feet on each side of construction and expansion joints and such other areas as the Engineer may direct.

During the placing of concrete, provision shall be made for the construction of joints and the placing of dowels, tie bars, and other devices as called for by the plans or as directed by the Engineer.

Concrete that is not in place within 90-minutes after being mixed (or 1-hour if mixed at a central plant or in transit) shall be subject to rejection and wasting at the direction of the Engineer. Concrete that has begun to harden or take an initial set prior to placement, or that has been re-tempered with water will be rejected and shall be wasted by the Contractor in an approved manner and at no expense to the City.

606.03.09 *Tamping and Screeding*

Compact the concrete pavement by means of vibrating screeds, mechanical tampers, tamping templates, and such other implements as approved. A vibratory screed or an automatic screeding and tamping machine may be substituted for a tamping template, subject to approval by the Engineer. Operate the equipment in such a manner that a satisfactory compaction of the concrete is produced and the surface of the pavement is uniform, true to grade and cross section.

Immediately after placing concrete upon the subgrade and before initial set has occurred, strike off the concrete and tamp by means of a tamping template used at right angles to the centerline of the street until the concrete is thoroughly consolidated to specified grade and crown section, and sufficient mortar is brought to the surface for finishing purposes. If the design or location of the base is such as to preclude the possibility of tamping as previously described (such as a variable crown section, curb being constructed monolithic with base, in alleys, or where the grade exceeds 10%), employ other approved methods to obtain the prescribed results.

606.03.10 *Finishing*

After the concrete is placed and compacted, strike it true to line, grade, and cross section as shown and float to a smooth, even texture with an approved long-handled wood float having a troweling or smoothing surface from 6 to 12-inches wide, or other approved floating device. Apply the float to the surface of the concrete with its length parallel to the centerline of the street and operate it from bridges, planing off the high places and filling the low places. Lap preceding applications of the float by at least one-half its length. If, after such planing, low places are discovered in the surface of the concrete, add specified grade, cross section, and surface tolerance with a surface free from laitance, soupy mortar, marks, or irregularities.

Fill any areas of minor honeycomb or other minor defect in composition of the concrete along the exposed edges with a stiff mortar or cement and fine aggregate applied to the moistened concrete in a workmanlike manner. Areas showing serious defects in composition of the concrete shall be cause for removal of

affected pavement and replacement with pavement of specified quality for the full width of strip between longitudinal joints or edges and for a length not less than 10-feet.

Tool the free edges of new pavement and joints with previously placed portland cement concrete with an approved edging tool to remove laitance and mortar resulting from finishing operations and to provide a clean rounded edge to the new pavement. Tooling shall not form ridges on the surface of the concrete. Perform tooling of edges at transverse joints and longitudinal joints as directed.

Upon completion of the floating, straightedge testing, and edge-tooling, and before initial set of the surface concrete, give the surface of the concrete a textured finish. Accomplish the textured finish with a steel-tine tool with 1/8-inch tines that will mark the finished concrete to a depth of 1/8-inch to 3/16-inch. Randomly space the markings from 1/2-inch to 1 1/4-inch as approved. Avoid overlaps of the texturing. Markings shall be transverse to the roadway centerline and full roadway width.

606.03.11 *Joints*

Conform to applicable requirements of **Section 208**.

606.03.12 *Tolerances*

At the conclusion of the finishing operation, the surface of the pavement shall not vary from a true surface, when tested with a 12-foot testing straight-edge, more than 0.02 of a foot in 12-feet.

The finished surface shall not vary more than 0.03-foot from the design elevations at any point.

If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, grind the high spots until they meet the tolerance. The practicable extent of grinding shall not exceed 0.5-inch, nor create spalling of aggregate, nor create deficiencies in pavement thickness. If approved by the City, low spots, if in hardened concrete, may be filled with an approved epoxy grout provided such filling is performed in a neat, workmanlike manner and blended inconspicuously with adjoining concrete. All repairs to be at no expense to the City.

606.03.13 *Curing and Protection of Concrete*

Cure and protect concrete in accordance with **Subsections 208.03.14 and 208.03.15**.

606.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

606.04.01 *Measurement*

606.04.01A *Portland Cement Concrete Pavement*

Measurement of portland cement concrete pavement will be made on a square yard basis for the pavement complete in-place as specified and accepted. Measurement will be made of width and length of each separately constructed strip of pavement, wherein the width is the design width or edge-to-edge width of pavement, whichever is the lesser, and the length is from end to end of pavement to the nearest 0.1-foot and the calculated square yardage shall be to the nearest square yard.

Extra thickness of pavement, when shown or specifically directed to be placed, will be measured by conversion on a proportionate volume basis to an equivalent number of square yards of specified standard thickness pavement.

606.04.02 *Payment*

Payment will be made for any or all of the following items when listed as pay items in the Contract Documents for any particular contract.

	Payment Item	Unit of Measure
1.	Continuously Reinforced Concrete Pavement (specify class, thickness, reinforcing steel)	Per Square Yard
2.	Reinforced Concrete Pavement (specify class, thickness, reinforcing steel)	Per Square Yard
3.	Plain Concrete Pavement (specify class, thickness)	Per Square Yard

Payment for concrete pavement, whether continuously reinforced, reinforced, or plain shall be full compensation for furnishing and placing all materials including, but not limited to, water, reinforcement, joint materials, dowels, tie bars, and performing all work specified to complete the item including preparation of the base.

607 CURBS, GUTTERS, DRIVEWAYS, AND SIDEWALKS

607.01 DESCRIPTION

This section covers work necessary for the construction of curbs, gutters, combination curb and gutter, combination of curb, gutter and sidewalk, islands, traffic separators, driveways, sidewalks, and pathways, hereinafter referred to collectively as structures. Conform to applicable requirements of *Section 208*.

607.02 MATERIALS

607.02.01 General

Materials shall conform to requirements of *Section 205* and to additional requirements contained herein.

607.02.02 Portland Cement Concrete for Extrusions

Grade the combined aggregates within the following limits:

Sieve Sizes	Total Passing Percent by Weight
1/2"	100
3/8"	75 – 100
No. 4	50 – 75
No. 16	20 – 40
No. 50	5 – 15
No. 100	0 – 5

607.02.03 Portland Cement Concrete

Portland cement concrete shall conform to *Subsection 205.02.09* except that extruded curbs and/or gutters shall have a maximum slump of 2-inches.

607.02.04 Aggregate

Aggregate materials for base, foundation, courses, leveling courses, or bedding shall conform to 1"-0" gradation in *Section 603*.

607.03 CONSTRUCTION

607.03.01 Preparation of Base

607.03.01A Earthwork

When roadway earthwork is called for in connection with other items of work under the same Contract Documents that include structure construction under this section, all excavation, backfilling, and berm construction for the structures and in the vicinities thereof as required or as shown shall conform to applicable requirements of *Section 206*.

607.03.01B Aggregate Foundation or Bedding

Construct sidewalk structures on aggregate foundation course or bedding of selected granular material as specified.

When structures are to be constructed on areas where approved aggregate material is already in place, such materials may be salvaged and reused as bedding.

Foundation courses or beddings involving the furnishing of new materials shall be constructed in conformance to the applicable requirements of *Section 603*.

607.03.01C Base for Portland Cement Concrete

All bases upon which new cement concrete structures are to be constructed shall be firm and free of all deleterious matter. Thoroughly dampen surfaces upon which new cement concrete is to be placed. No separate payment will be made for water and the work of placing base materials. The cost of preparing bases shall be considered as incidental to the construction of structures. See *Subsections 601.03.08 and 603.03.04* for compaction requirements.

When new concrete is placed by the mechanical extrusion method, if approved by the Engineer, vertical dowel fastening to underlying concrete or asphalt may be eliminated when the bond between new concrete and underlying concrete or asphalt is provided with epoxy cement applied in conformance with the manufacturer's recommendations. Spread epoxy at a rate that will provide a thorough coating to the surface with all voids and depressions filled. Place new structure on the epoxy cement within 15-minutes after spreading.

607.03.02 Forms

Conform to requirements for forms in *Section 208*.

607.03.03 Equipment

Conform to the requirements of *Sections 605 and 606* unless otherwise specified herein by the Engineer. For asphalt sidewalks or islands, spread asphalt concrete by small or special pavers, by spreader boxes, or by blade graders. Compact with small, self-propelled rollers, vibratory compactors, or mechanical tampers. Spread or compact the mixture by hand methods only when approved.

The machine for extruding cement concrete curb shall be of the self-propelled type equipped with a material hopper, distributing screw, and adjustable curb forming devices capable of placing and compacting cement concrete to the lines, grades, and cross section as shown in an even homogeneous manner.

Set top of curb grade by an offset guideline using the survey marks established by the Engineer of Record. The forming tube portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to provide, when necessary, a variable height of curb conforming to the predetermined curb grade. A grade line gauge or pointer shall be attached to the machine in such manner that a

continual comparison can be made between the curb being placed and established curb grade as indicated by the offset guideline.

In lieu of the above method for maintaining the curb grade, the extrusion machine may be operated on approved rails or forms set at the proper relative grade.

607.03.04 *Placing Material*

No asphalt or concrete shall be placed until the surface and forms, where used, have been inspected and approved.

607.03.04A *Portland Cement Concrete*

Construct portland cement concrete structures between specified forms or by a mechanical extrusion method as the Contractor may elect. If forms are used, maintain a 2 to 4-inch slump and thoroughly compact and strike off. If the structures are constructed by a mechanical extrusion method, maintain a maximum slump of 2-inches. Feed cement concrete into the extruding machine at a uniform rate and operate the machine under sufficient restraint in a forward motion to produce a well-compacted mass of concrete.

607.03.05 *Finishing*

607.03.05A *General*

Construct all structures within ¼-inch of true line and within ¼-inch of established surface grade, cross-section, and slope and within ¼-inch of specified thickness; all finished surfaces shall be free from humps, sags, or other irregularities. When a straightedge 12-foot long is laid on a finished surface, the surface shall not vary more than 0.02-feet from edge of the straightedge.

Where portland cement concrete sidewalks or pathways are to be placed around or adjacent to manholes, pipe inlets, or other miscellaneous structures, form around the miscellaneous structure and allow one panel of clearance. After the sidewalk is poured and cured, adjust miscellaneous structures to grade and finish placing the sidewalk or pathway panel(s).

607.03.05B *Portland Cement Concrete*

Sidewalks, Curbs, and Other Structures:

Finish surface of concrete to grade and cross section with a bull float, trowel smooth, score if required, and then finish with a broom. Use floats of not less than 10-feet in length for straight grade sections and not less than 6-inches in width. Finish concrete adjacent to expansion joints with an edger tool. Light brooming shall be transverse to the line of traffic; if water is necessary it shall be lightly applied to the surface immediately in advance of brooming.

The surface of concrete shall be marked into squares based on full width with a scoring tool that will leave the edges rounded. For widths greater than 7-feet, scoring and dimensions shall be as shown on the appropriate plan sheet or as directed by the Engineer. Sidewalks shall have a slope of 2% from the top of curb to the back of walk. The faces that are to be exposed shall be free from chips, cracks, air holes, honeycomb, or other imperfections. If portions of the work are deemed unacceptable by the Engineer, they shall be removed and replaced between the nearest joints at no expense to the City.

Curbs:

All concrete curbs shall be cast-in-place.

Remove forms after the concrete has taken initial set and while the concrete is still green. Minor defects shall be repaired with mortar containing 1 part portland cement and 2 parts sand. Plastering will not be permitted on the faces and exposed surfaces. Structurally defective concrete shall be removed

and replaced at no expense to the City. While the concrete is still green, finish exposed surfaces as required to provide a uniform texture and smooth surface.

When constructing concrete curbs, the proportions of sand, gravel, and cement, the type of forms used (if applicable), and the method of compacting the concrete in the forms shall all be such that as dense, smooth, and uniform a surface as is practicable for a concrete masonry unit will be obtained on the finished curb.

Furnish and install a minimum of two 3-inch PVC Schedule 40 pipe curb drains to serve each lot per Standard Detail 602 or 603. Curb drains shall be installed during curb construction. In cases where curb drains are installed in existing cured concrete curbs, the curb must be cored. Breaking or sawing out sections of the curb for curb drains will not be permitted. PVC pipe shall conform to ASTM D-2241. Curb drains will be considered incidental work for which no separate payment will be made.

607.03.06 *Curing Portland Cement Concrete*

After the concrete has been placed and finished in structures as specified, it shall be cured by application of a white pigmented, liquid membrane-forming compound applied uniformly to the damp concrete by pressure spray methods according to **Subsection 208.03.14**. The concrete structure shall be kept free from contact, strain, and public traffic for at least 7-days.

607.03.07 *Joints in Portland Cement Concrete*

Contraction Joints in Walks and Incidental Surfacing:

Form transverse contraction joints of the weakened plane in the exposed surfaces of cement concrete walks and incidental surfacings at such locations as are required to confine the contraction joint spacing to a maximum of 15-feet. The joints shall be formed to a depth of $\frac{1}{3}$ of the thickness of concrete and to a width of about $\frac{1}{8}$ -inch. Joint edges shall be tooled. Contraction joints should coincide with joints in cures.

Contraction Joints in Curbs:

Place contraction joints in curbs at intervals not exceeding 15-feet. Contraction joints shall be of the open joint type and shall be provided by inserting a thin, oiled steel sheet vertically in the fresh concrete to force coarse aggregate away from the joint. The steel sheet shall be inserted $\frac{1}{2}$ the depth of the curb. After initial set has occurred in the concrete the steel sheet shall be removed with a sawing motion. Finish edges with a steel-edging tool. Contraction joints of curbs should coincide with joints in sidewalks and streets.

Expansion Joints:

Transverse expansion joints for curbs shall be provided opposite abutting expansion joints in portland cement concrete and over expansion joints in concrete underlying the new concrete. Additional transverse expansion joints shall be provided at other locations as required to confine the expansion joint spacing to the maximum distance indicated on the plans. The width of joint and thickness of filler shall match those of the joints in abutting or underlying concrete, and elsewhere shall be $\frac{1}{2}$ -inch. Each expansion joint shall be at right angles to the structure alignment, normal to the structure surface, and shall provide complete separation of new concrete.

Expansion joints for sidewalks and driveways shall be provided around poles, pipes, and conduit that protrude through, into, or against the structures, and alongside or transverse to the new surfacing at such locations and frequencies as is necessary to provide for expansion of both new and abutting portland cement concrete.

Requirements Near Existing Structures:

Cut back existing curbs, walks, driveways and other such structures to permit the new construction; where the new structures are to be constructed against or within 4-inches of the end, edge, or side of other structures, the new construction shall include the construction of approved connections therewith using the same

kind of concrete as is used in the new construction. Make the joint between the old and new material with a sawcut at the nearest existing joint.

607.03.08 *Dowels, Tie Bars, and Reinforcing*

Provide metal reinforcing bars and wire fabric reinforcement when and as shown. Welded wire fabric shall conform to ASTM A-185. When shown, provide and place dowels with “slip sleeves” as load transfer mediums. Provide and place dowels (without “slip sleeves”) as fastenings or ties between new concrete and existing underlying concrete when shown. Provide tie bars when shown. Place reinforcing dowels and tie bars in conformance to the applicable requirements in *Section 205*.

607.04 *MEASUREMENT AND PAYMENT* *(Not applicable to privately financed public improvement projects)*

607.04.01 *Measurement*

607.04.01A *Curbs*

Curb will be measured on a lineal foot basis along the face of the curb for the actual length constructed.

607.04.01B *Combination Curb and Gutter*

Combination curb and gutter will be measured on a lineal foot basis along the face of the curb for the actual length constructed.

607.04.01C *Sidewalks and Pathways*

Sidewalk shall be measured on a square yard basis for the actual square yards of sidewalk constructed.

The second component curb and gutter shall comprise the portion of the combined section beginning at the back of curb and through the gutter section, and shall be measured on a linear foot basis for the actual linear feet of curb and gutter constructed.

607.04.01D *Concrete Valley Gutter*

Concrete valley gutter will be measured on a lineal foot basis for the actual length of gutter constructed.

607.04.01E *Traffic Islands*

Traffic islands will be measured by component parts of curb and sidewalks as described above.

607.04.01F *Driveways*

Measurement of portland cement or asphalt concrete driveways will be made on a square yard basis on the actual surface of the specified thickness concrete or asphalt completed and accepted.

607.04.01G *Sawed Joints*

Sawed joints will be measured on a lineal foot basis for each joint sawed, cleaned, and sealed as specified and directed by the Engineer.

607.04.01H Aggregate Base

Pay quantities of aggregate base material will be measured as set forth in **Section 603.**

607.04.02 Payment

Payment will be made for any or all of the following items when listed as pay items in the Contract Documents for any particular contract and will include full compensation for all labor, materials, and equipment:

	Payment Item	Unit of Measure
1.	Curb (specify asphalt or concrete)	Per Lineal Foot
2.	Concrete curb and gutter	Per Lineal Foot
3.	Sidewalk	Per Square Yard
4.	Concrete valley gutter	Per Lineal Foot
5.	Driveway (specify thickness)	Per Square Yard
6.	Sawed joints	Per Lineal Foot*
7.	Aggregate base	Per Cubic Yard*
*	When neither specified nor shown in the Contract Documents for separate payment, it shall be considered incidental to the other items of work and no separate payment will be made.	

608 GEOTEXTILE FABRICS

608.01 GENERAL

This work consists of furnishing and placing geotextile fabrics on subgrades (subgrade geotextile) and beneath an asphalt overlay (pavement overlay geotextile) as shown on the plans or as directed by the Engineer.

608.02 MATERIALS

Geotextile materials shall conform to **Subsection 205.02.11.**

608.03 CONSTRUCTION

608.03.01 General

General requirements for placement of geotextile shall be in accordance with **Subsection 205.03.**

608.03.02 Subgrade Geotextile

For roadbed subgrade separation, prepare the subgrade according to **Section 601.**

Correct geotextile failures, as evidenced by soil pumping or roadbed distortion, by removing any covering material in the affected area and placing a geotextile patch on the exposed geotextile. The patch shall overlap the exposed geotextile a minimum of 12-inches. Cover the patch with the specified cover material and compact before proceeding.

608.03.03 *Pavement Overlay Geotextile*

(a) GENERAL – Place geotextile and pavement overlay in four basic steps:

- Surface preparation
- Sealant application
- Geotextile placement
- Overlay placement

(b) WEATHER LIMITATIONS – Place sealant and geotextile in accordance with ***Subsection 605.03.12***, except the minimum air temperature shall be 50° F for paving grade asphalt sealant placement and 60° F for asphalt emulsion sealant placement.

(c) SURFACE PREPARATION – Prepare the pavement surface on which the sealant is to be placed according to specifications and the following:

- Clean and fill cracks exceeding 1/8" width with an approved asphalt crack filler.
- Repair minor irregularities or depressions as directed.
- Allow crack filling material to cure before placing geotextile.
- Where the pavement is severely cracked, rutted, deformed, or otherwise distressed, place a leveling course as directed by the Engineer instead of extensive surface preparation.

(d) SEALANT APPLICATION – Use a normal paving grade asphalt. A cationic or anionic emulsion may be used as approved. Do not use cutbacks or emulsions that contain solvents.

Uniformly spray the asphalt sealant at normal application temperature by means of a pressure distributor on the prepared dry pavement surface. Apply at the normal rate of 0.20 to 0.30 gallon per square yard or as recommended by the geotextile manufacturer when directed by the Engineer.

If using emulsions, increase the application rate 50% or as directed by the Engineer. Some underlying surfaces may require a higher application rate. Within street intersections, on steep grades, or in other zones where vehicle speed changes are commonplace, reduce the normal application rate by 20% or as directed by the Engineer.

The target width of sealant application shall be geotextile width plus 6-inches. Apply the sealant only as far in advance of geotextile installation as appropriate to ensure a tacky surface at the time of geotextile placement. Place geotextile the same day as the sealant. Do not allow traffic on the sealant. Clean excess asphalt from the road surface.

(e) GEOTEXTILE PLACEMENT – Place the geotextile into the sealant using mechanical or manual lay-down equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding before the sealant loses tackiness. When asphalt emulsions are used, allow the asphalt to separate from the water (break) before placing the geotextile.

Slit wrinkles or folds exceeding 1-inch and lay flat. Shingle-lap not more than 6-inches in the direction of the paving. Broom and/or pneumatic roll to maximize geotextile contact with the pavement surface. Additional hand-placed sealant material may be required at laps as determined.

Limit traffic to necessary construction equipment and emergency vehicles on the geotextile before and during paving unless otherwise directed. Turn the paver and other vehicles gradually. Keep turning to a minimum to avoid geotextile movement and damage. Avoid abrupt starts and stops.

(f) OVERLAY PLACEMENT – Place the overlay the same day the geotextile is placed. Remove sealant that bleeds through the geotextile. Do not windrow asphalt concrete material on the geotextile ahead of the paving machines. Do not use an asphalt concrete material pickup machine. In the event of rain, the Contractor shall place sand over uncovered fabric to absorb sealant.

608.04 MEASUREMENT AND PAYMENT *(Not applicable to privately financed public improvements)*

Payment for the work in this section shall be in accordance with **Subsection 205.04**.

609 COLD PLANE PAVEMENT REMOVAL

609.01 GENERAL

This work shall consist of preparing a foundation for placement of new surfacing by removal of existing surfacing to the depth, width, and cross section shown on the plans.

609.02 WORKMANSHIP

609.02.01 Equipment

The existing surfacing shall be removed with a self-propelled planning machine or grinder. The equipment shall be capable of accurately establishing profile grades within a tolerance of 0.02-foot by reference from either the existing pavement or from independent grade control, and shall have a positive means for controlling cross slope elevations. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.

When existing structures exist in the area of work, smaller equipment and handwork may be necessary to remove the material adjacent to the structures.

609.02.02 Pavement Removal

The existing pavement shall be removed to the depth, width, grade, and cross section shown on the plans or as directed by the Engineer to provide a surface profile true to specified grade and transverse slope.

Except where samples are taken to establish a job mix formula, the existing surfacing shall not be removed more than 5-days prior to construction of the new surfacing unless otherwise approved by the Engineer.

Wherever samples are obtained from existing surfacing more than 5-days prior to construction of the new surfacing, the Contractor shall patch the samples areas with asphalt concrete at no expense to the City.

All material to the depths specified shall be removed adjacent to existing structures and the structures shall be adjusted in accordance with **Section 610** at no additional expense to the City.

609.02.03 Surface Tolerance

The new surface resulting from the pavement removal will be tested by the Engineer for trueness to specified grade and transverse slope at selected locations. Testing will be with a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any 2 contact points shall not exceed 0.02-foot.

609.02.04 *Disposal of Materials*

Materials removed under this specification that are not recycled and used on the project shall become the property of the Contractor at the point of removal and shall be disposed of off the limits of the project in a manner satisfactory to the Engineer.

The Contractor is encouraged to salvage any removed, cold-planed materials that are not recycled and used on the project for use on future projects.

609.03 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

Materials removed under this specification, regardless of thickness, will be measured for payment on a square yard basis. The pay quantities will be determined by measurement of the actual surface of the area from which the materials have been removed and computed to the nearest 0.1 square yard.

610 ADJUSTMENT OF STRUCTURES TO GRADE

610.01 *DESCRIPTION*

This section covers the work necessary for adjusting tops of structures (e.g., manholes, sumps, catch basins, inlets, valve boxes, meter boxes, monument boxes, and similar structures) to required elevation and/or horizontal alignment complete.

610.02 *MATERIALS*

610.02.01 *General*

Materials used in adjustment of existing structures shall be materials salvaged from the existing installation and brought to a condition approved for reuse by the Engineer. If existing materials cannot be brought to a condition approved for reuse, new materials must be supplied at no additional cost to the City.

610.03 *CONSTRUCTION*

610.03.01 *General*

Excavation shall be unclassified and shall include whatever materials are encountered to the depths as necessary to accomplish the work.

Except for overlay work, structures such as manholes, sumps, catch basins, inlets, and similar structures shall be adjusted to final finished grade before the final lift of paving. When these structures are affected during overlay work, adjust them according to Standard Detail 645. Do not use a jackhammer for pavement cutting. For all paving work, structures such as valve boxes, monument boxes, and similar structures shall be loosened and otherwise repaired prior to final lift of paving and shall be adjusted to final finished grade during the installation of the final lift of paving.

Backfill shall be done in accordance with the applicable requirements of *Section 206*.

610.03.02 *Salvage of Existing Structures*

Metal frames, covers, grates, and fittings may be salvaged from structures to be adjusted or abandoned.

Salvaged components to be reused shall be cleaned of foreign material by solvents, sand blasting, or other methods that will not harm the component but will restore it to a nearly new condition. Salvaged structures not reused on the project shall become the property of the City.

610.03.03 *Raising Tops of Masonry Structures*

After existing frames, covers, and grates have been removed, expose the top surface on which new concrete is to be placed and chip away at least ½-inch to expose firm concrete. The new surface shall be cleaned by brushing and shall be moistened with water at the time of placing new concrete. New concrete shall then be placed to required grade and cured at least 7-days after which the frame shall be seated in fresh mortar and brought to the proper grade.

Masonry of bricks or concrete blocks shall be raised with new bricks, blocks, mortar, or combinations thereof or with portland cement concrete as conditions may require. Concrete boxes may be lifted and placed on precast concrete box extensions, on new brick, or on cast-in-place concrete as may be suitable.

Mortar for building up existing masonry shall not be placed to a depth exceeding 1-inch. Concrete shall not be placed to a depth of less than 4-inches. To conform to these requirements, existing shells or walls of structures to be raised shall be cut down as necessary to provide space for the new construction.

Fabricated metal rings or plates may be furnished and used in adjustment work, provided the metal and its fabrication design is at least equal to specified characteristics of strength and support required of the covers or grates to be placed, that uniform bearing of bearing surfaces is assured, and that positive provision is afforded against displacement when in service.

610.03.04 *Lowering Tops of Masonry Structures*

Where the top of an existing masonry structure is to be lowered, the masonry portion of the structure shall be exposed to required depth and cut off or removed to an elevation below that established for the bottom of metal frame or cover which is to be reset on masonry, and shall then be built up with mortar, concrete, brick, or concrete blocks, or with metal rings or plates to required elevation and top design. Joining of new material to old (minimum thicknesses of new mortar and concrete, limitations, curing, and other details) shall be as specified in **Section 208**. The Engineer of Record shall certify that the strength and loading capacity of the structure has not been compromised or the structure shall be removed and replaced with a structure with adequate strength and loading capacity.

610.03.05 *Adjusting Metal Structures*

Metal inlets, valve boxes, meter boxes, monument boxes, or other like structures shall be normally raised or lowered to grade by resetting the entire structure on firm foundation. In the case of raising the structure to a point where it would not enclose or protect its contents, add metal extensions of like design below the original structure. Contractor may replace the structure with a new structure of adequate design as approved and at no expense to the City. Salvaged structures not reused on the project shall become the property of the City. Metal structures shall meet the surface smoothness requirements of **Subsection 505.03.19**. Conform to applicable Sections of **DIVISIONS THREE AND FOUR**.

610.04 *MEASUREMENT AND PAYMENT (Not applicable to privately financed public improvements)*

610.04.01 *Measurement*

When no pay item is listed in the Contract Documents, all work will be considered as incidental to the other pay items and no separate payment will be made.

When listed in the Contract Documents, measurement will be the actual number of manholes, sumps, catch basins, inlets, valve boxes, meter boxes, monument boxes, and other like structures adjusted under this section, measured as units in place, completed and accepted. Separate measurement will be made of each specific type or of each separate grouping of types of structures for which separate items are shown in the Contract

Documents. Required earthwork, backfill, replacement of base drains, stone bases, pavements, and other miscellaneous work will be considered as incidental to the adjusting work and no separate measurement thereof will be made.

610.04.02 Payment

When listed in the Contract Documents, the accepted units in place will be paid for at the applicable contract unit price per each for the particular pay items listed below and shown in the Contract Documents.

	Pay Item	Unit of Measurement
1.	Adjusting Manholes	Each
2.	Reconstructing Concrete Manholes	Each
3.	Adjusting Inlets	Each
4.	Adjusting Boxes	Each

Items 1 and 2 above refer to manholes, sumps, and like structures designed to permit human entry and working space therein, and to confine and control the flow of pipe-conveyed liquids – which structures are herein collectively referred to as manholes.

Item 1 above applies to manholes (regardless of the kind of materials of which they are composed and regardless of design, type, or depth) that have had the tops thereof adjusted as specified, except as Item 2 is applicable as hereinafter provided.

Item 2 above refers to monolithic concrete manholes that, in having their tops adjusted as specified, have necessarily had their entire existing cones destroyed and new cones constructed, or had their entire existing top slabs destroyed and new slabs constructed, or precast manholes that have necessarily had adjustments made below the cone.

Item 3 above refers to inlets and catch basins, defined as structures designed to receive surface water through grates and orifices and to discharge said waters under control through pipes and is applicable to such structures regardless of their designs, types, or sizes.

Item 4 refers to valve boxes, meter boxes, monument boxes, and other like structures that are comprised of a box-like body and removable cover provided for the protection of and access to meters, valves, markers, monuments, shut-offs, and similar items. If a protective coating is required on the new metal used in the work, the coating shall be provided as an incidental item without separate or additional compensation.

****END OF DIVISION****

CITY OF GRESHAM
PUBLIC WORKS DESIGN STANDARDS

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SECTION ONE – GENERAL

1.01 AUTHORITY AND PURPOSE

In 1999 the City of Gresham adopted a revised Gresham Community Development Plan that regulates land use and development issues within the City. This comprehensive planning document consists of three volumes. Volume III, titled Gresham Community Development Code, consists of thirteen articles defining separate development standards. Appendix 5.0000 – Public Facilities discusses generalized public facility design requirements and requires compliance with the Gresham Public Works Construction Standard Specifications, or the shortened version known as the Construction Specifications. The information contained in this document shall be known as the Gresham Public Works Design Standards or, in the shortened version, as the Design Standards.

The purpose of these Design Standards is to provide a consistent policy under which certain physical aspects of public facility design shall be implemented. Most of the elements contained in this document are public works oriented and it is intended that they apply to both publicly financed public improvements under City contract and privately financed public improvements under private contract designated herein.

These Design Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. It is expected that engineers will bring to each project the best of skills from their respective disciplines.

The Design Standards are also not intended to unreasonably limit any innovative or creative effort that could result in better quality, better cost savings, or both. Any proposed departure from the Design Standards will be judged, however, on the likelihood that such variance will produce a compensating or comparable result in every way adequate for the user and City resident.

Alternate materials and methods will be considered for approval by the Engineer as the need arises and conditions warrant modification. This consideration will be on a case-by-case basis and require sufficient justification prior to approval.

1.02 DEFINITIONS

Alley – A public access easement or right-of-way not more than 20-feet and not less than 12-feet in width that intersects with a public street.

Approved Backflow Prevention Assembly – A testable assembly that has been investigated and approved by the Oregon State Health Division.

Arterial Street – A major facility for moving intra-area traffic and for moving traffic to and from the freeway/expressway system.

As-Built Plans – Plans signed and dated by the Engineer of Record indicating that the plans have been reviewed and revised, if necessary, to accurately show all as-built construction. Also referred to as record drawings.

Average Daily Demand – The total volume of water delivered to the system in 1-year divided by 365-days.

Backflow – The reverse of flow from its normal or intended direction of flow. Backflow can be caused by back-pressure or back-siphonage.

Backflow Preventer – An approved testable assembly or means to prevent backflow into the potable water system.

Back-siphonage – Backflow that results from negative pressure (partial vacuum) in the supply piping system.

Bike Lanes – A designated travel-way for bicyclists that is established within the roadway directly adjacent to the outside vehicular lane or on the shoulder.

Bike Path – A designated travel-way for bicyclists that is completely separated from the vehicular travel lanes and is within independent rights-of-way.

Bike Route – A designated travel-way for a bicyclist that is shared with vehicular traffic. The roadway is designated with signs for bicycling (no pavement markings for the bike route or delineation of parking spaces is used).

Building Fire Flow Requirements – Fire flow requirements based on type of occupancy and building material construction.

Building Service Lateral – A public wastewater sewer between the property line or public easement line and the wastewater sewer main.

Building Sewer – A private wastewater sewer between the property line or public easement line connecting to the building service lateral and a point 5-feet outside the building.

Building Supply – The pipe carrying potable water from the water meter or other source of water supply to a building or other point of use or distribution on the lot. Building supply shall also mean customer line.

CAD – Computer aided design.

City – The City of Gresham, Oregon.

Collection Systems – Facilities maintained by the City connected thereto for the collecting, pumping, conveying, and controlling of wastewater.

Collector Sewer – The portion of the public wastewater system that is primarily installed to receive wastewater directly from individual residences and other individual public or private structures.

Collector Street – A facility that allows traffic within an area or neighborhood to connect to the arterial system.

Core – To cut and remove a portion of pipe, manhole, or pavement with a circular hollow drill.

Cross Connection – Any physical connection between foreign material, including other water sources, and the potable water that the system supplies.

Cul-de-sac – A dead-end street having a circular turnaround area at the end.

Curb – The line indicating the edge of the vehicular roadway within the overall right-of-way.

Cut Sheets – Sheets of tabulated data indicating stationings, structures, fittings, angle points, beginning of curve, points on curve, end of curves, street grade, pipe slope, staking offset, various elevations, and offset cuts for streets, waterlines, wastewater sewers, and storm drains.

Datum, Horizontal – The horizontal control network of the City was adjusted to the North American Datum 83(91) expressed in Oregon North Zone State Plane Coordinates in international feet.

Datum, Vertical – The vertical elevation control for the City is "The National Geodetic Vertical Datum of 1929" that corresponds to the USC&GS 1947 Datum.

Dead-end Street – A street or series of streets that can be accessed from only one point. Dead-end streets can be either temporary (intended for future extension as part of a future street plan) or permanent. Permanent dead-end streets must provide adequate turn-around capability.

Definition of Words – That whenever in these Standards, the words “directed”, “required”, “permitted”, “ordered”, “designated”, or words of like importance are used, they shall be understood to mean the direction,

requirement, permission, or order of designation of the Engineer. Similarly, the words “approved”, “acceptable”, or “satisfactory”, shall mean approved by, acceptable to, or satisfactory to the Engineer.

Demand – The total quantity of water supplied for a given period of time to meet the various required uses. The various uses include residential, irrigation, commercial, and industrial uses as well as fire fighting, system losses, other unaccounted for, and miscellaneous uses.

Design Intensity – The uniform rainfall intensity, inches per hour, associated with a duration equal to the time of concentration of the basin and a specified return frequency (e.g., 2-year, 10-year, etc.) that is used to calculate the peak discharge rate to be used for stormwater conveyance system design.

Design Storm – A rainfall event of a specified duration (e.g., 6-hour, 12-hour, 24-hour) and return frequency (e.g., 2-years, 10-years, etc.) that is used to calculate the runoff volume and/or discharge rate to be used for stormwater system design.

Designated Arterial or Collector Street – A street designated as an arterial or collector in the Comprehensive Plan.

Detention – The storage and subsequent release of excess stormwater runoff to control peak discharge rates prior to discharge to the storm drain or natural drainageway.

Detention Volume – The storage volume required to control the peak discharge rates at the point of discharge from a development.

Development – Any man-made change to improved or unimproved real estate, including but not limited to construction, installation, or alteration of buildings or other structures, condominium conversion, land division, establishment or termination of a right of access, storage on real property, tree cutting, and clearing, mining, dredging, filling, grading, paving, excavation or drilling operations.

Direct Discharge – Any stormwater discharge from a developed site that has not passed through approved water quality treatment prior to its ultimate outfall to a natural drainageway, wetland, or other natural resource area.

Domestic Wastewater – The liquid and water-borne waste derived from the ordinary living processes, free from industrial wastes, and of such character to permit satisfactory disposal, without special treatment, into the public wastewater system or by means of private wastewater disposal system.

Double Check Detector Assembly – A line-sized, approved double check valve assembly with a parallel meter and meter-sized, approved double check valve assembly. The purpose of this assembly is to provide backflow protection for the distribution system and, at the same time, provide a metering of the fire system showing any system leakage or unauthorized use of water.

Double Check Valve Assembly – An assembly composed of two single, independently acting approved check valves, including tightly closing shut-off valves located at each end of the assembly and fitted with properly located test cocks.

Drainage Facilities – Pipes, ditches, detention basins, creeks, culvert bridges, etc., used singularly or in combination with each other for the purpose of conveying or storing stormwater run-off.

Drywell – See Stormwater Sump.

Easement – Areas located outside of dedicated rights-of-way that are granted to the City for special uses and public facilities.

Engineer – The applicable City Department of Environmental Services division manager or designee who is licensed as a registered professional engineer in the State of Oregon.

Engineer of Record – A registered professional engineer licensed to practice in the State of Oregon who is responsible for the design of a public improvement project and has stamped the plans.

Expansion Joint – A joint to control cracking in the concrete surface structure and is filled with preformed expansion joint filler.

Fire Protection Service – A metered connection to the public water main intended only for the extinguishment of fires and the flushing necessary for its proper maintenance.

French Drain or Leach Line – A covered underground excavated trench filled with washed gravel that surrounds a perforated delivery pipe used to receive storm water, wherein the sides and bottom of the trench are porous, permitting the storm water to seep into the ground.

Grade – The degree of inclination of a road or slope.

Hydrant Lead – The waterline connecting the fire hydrant to the auxiliary valve on the City distribution main.

Impervious Areas – Those hard surface areas located upon real property that either prevent or retard saturation of water into the land surface, as existed under natural conditions pre-existent to development, and cause water to run off the land surface in greater quantities or at an increased rate of flow from that present under natural conditions pre-existent to development.

Industrial Waste – Solid, liquid, or gaseous waste resulting from any industrial, manufacturing, trade, or business process from development, recovery, or processing of natural resources.

Interceptor Sewer – A primary public wastewater pipe that conveys wastewater directly into the Wastewater Treatment Plant.

Irrigation Service – A metered connection intended for seasonal use and delivering water that is not discharged to the wastewater system.

Local Street – A facility designated to primarily serve direct access to abutting land and offers the lowest level of traffic mobility. Through-traffic movement is deliberately discouraged.

Longitudinal Joint – A joint, which follows a course approximately parallel to the centerline of the roadway.

Major Trees – Trees that are 30-inches or larger in diameter and are either within the right-of-way or public easement or are within 10-feet of the right-of-way or public easement. Major trees are protected by the City's "Trees First" policy and design modifications of public facilities may be required to accommodate tree preservation.

Manager – The City Manager of the City of Gresham acting either directly or through authorized representatives.

Maximum Daily Demand – The maximum volume of water delivered to the system in any single day of the year, divided by one day.

Minor Partition – See Partition.

Natural Grade – The grade of the land in an undisturbed state.

On-Site Detention – The detention of stormwater from a private storm drain in a privately owned and maintained storm drain system to provide a controlled release, at or below a maximum allowable rate, to the public storm drain system.

Outfall – The point at which collected, concentrated stormwater is discharged, generally from a pipe(s), from a development to an open drainage element such as a ditch, channel, swale, stream, river, pond, lake or wetland.

Owner – The owner of record of real property as shown on the latest tax rolls or deed records of the County, and includes a person who furnishes evidence that he is purchasing a parcel of property under a written recorded land sale contract.

Partition – To divide an area or tract of land into 2 or 3 parcels within a calendar year when such area or tract of land exists as a unit or contiguous units of land under single ownership at the beginning of such year.

Peak Hour Demand – The maximum volume of water delivered to the system in any single hour of the year multiplied by 1-hour.

Peak Run-off – The maximum stormwater runoff rate (CFS) determined for the design storm or design rainfall intensity.

Person – Individual firm, corporation, association, agency, or other entity.

Plans – The Standard Details or reproductions thereof and project specific plans, profiles, cross sections, elevations, details, and other working or supplementary drawings signed by the Engineer of Record that show the location, character, dimensions, and details of the work to be performed. Plans for privately financed public improvement projects must be approved by the Project Manager. Plans for publicly financed public improvement projects may either be bound in the same book as the balance of the Contract Documents or bound in separate sets and are a part of the Contract Documents regardless of the method of binding.

Potable Water – Water that is satisfactory for drinking, culinary, and domestic purposes and meets the requirements of the health authority having jurisdiction.

Private Collection System – A privately owned and maintained lateral wastewater system installed to serve multi-unit structures on single ownership properties that cannot legally be further divided.

Private Storm Drain – A storm drain located on private property.

Project Manager – The City's representative charged with the management of the project. For publicly financed public improvement projects the Project Manager is typically the Engineer or the Engineer's representative. For privately financed public improvement projects the Project Manager is typically a development specialist of the City.

Projected Maximum Daily Demand – The maximum volume of water anticipated to be delivered to the system in a future single-day of a year divided by 1-day.

Public Storm Drain – Any storm drain in public right-of-way or easement operated and maintained by the City.

Public Wastewater System – Any wastewater system in public right-of-way or easement operated and maintained by the City for carrying wastewater and industrial wastes.

Release Rate – The controlled rate of release of drainage, storm, and runoff water from property, storage pond, runoff detention pond, or other facility during and following a storm event.

Residential Street – See Local Street.

Retention – The process of collecting and holding surface and stormwater runoff with no surface outflow from a developed property.

Right-of-Way – A general term denoting public land, property, or interest therein acquired for or devoted to a public street or accessway.

Roadway – That portion of a street and its appurtenances, typically between curbs or ditches, primarily used for vehicular traffic.

Sedimentation – Deposition of erosional debris soil sediment transported by water.

Sewage – A combination of the water-carried wastes from residences, business buildings, institutions, and industrial establishments, except industrial wastes.

Sewer Lateral – A building’s wastewater service pipe.

Sidewalk – A path along the side of a road for pedestrians. A right-of-way deeded, dedicated, and designated for the use of non-motorized vehicles and pedestrians.

Silt – Fine textured soil particles, including clay and sand, as differentiated from coarse particles of sand and gravel.

Standard Details or Standard Detail Drawings – Detailed representations of structures, devices, or instructions set forth in the Public Works Standards.

Stormwater Sump – A drainage facility (or system) designed to utilize the infiltration capability of the ground, commonly referred to as percolation, to dispose of surface and stormwater runoff.

Streets – Any street, avenue, boulevard, alley, lane, bridge, bicycle path, road, public thoroughfare or public way, and any land over which a right-of-way has been obtained or granted for any purpose of public travel.

Structures – Those structures designated on the standard plans such as catch basins, manholes, etc.

Subdivision – To divide an area or tract of land into 4 or more lots within a calendar year when such area or tract of land existed as a unit or contiguous units of land under a single ownership at the beginning of such year.

Swale – A broad-bottomed, shallow, vegetation-lined channel that allows for reduced flow velocity and filtration of stormwater, generally with flow depths less than 1-foot.

Total Fire Flow – A combination of building fire-flow requirements, any internal system fire-flow requirements (e.g., sprinklers), and domestic maximum daily demand (highest 24-hour consumption within the last 3-years).

Transverse Joint – A joint that follows a course approximately perpendicular to the centerline of the roadway.

Treatment Volume – The storage volume necessary to provide the required level of water quality treatment of stormwater prior to discharge to a storm drain element, facility, or natural drainage element.

Trunk Sewer – A wastewater pipe that is primarily intended to receive wastewater from collector pipes, other trunk sewers, existing major discharges of raw or inadequately treated wastewater, or water pollution control facilities.

Turnaround Area – A paved area of sufficient size and configuration that a motor vehicle may maneuver so as to travel in the opposite direction.

Uniform Plumbing Code – The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials (current edition) as revised by the State of Oregon and called the “Oregon State Plumbing Specialty Code”.

Wastewater – The total fluid flow in the wastewater system that includes industrial waste, sewage, or any other waste (including that which may be combined with any ground water, surface water, or storm water) that may be discharged into the wastewater system.

Water Distribution System – Water distribution pipelines, pumping stations, reservoirs, valves, and ancillary equipment used to transmit water from the supply source to the service line.

Water Main – The water-supply pipe for public or community use.

Water Service Line – The pipe connection from the City water main to the metering device, hydrant, or fire line backflow prevention assembly.

Wet Weather Season – Defined for the purposes of construction and development in the City as the period between October 1st and the following May 31st.

Wetlands – Those lands adjacent to watercourses or isolated therefrom that may normally or periodically be inundated by the waters from the watercourse or the drainage waters from the drainage basin in which it is located. These include swamps, bogs, sinks, marshes, and lakes, all of which are considered to be part of the watercourse and drainage system of the City and shall include the headwater areas where the watercourse first surfaces. They may be, but are not necessarily, characterized by special soils such as peat, muck, and mud.

1.03 ENGINEERING POLICY

It shall be the policy of the City to require compliance with Oregon Revised Statute 672 for professional engineers.

All engineering plans, reports, or documents shall be prepared by a registered professional engineer or by a subordinate employee under the engineer's direction, and shall be signed by the engineer and stamped with the engineer's seal to indicate the engineer's responsibility for them. It shall be this Engineer of Record's responsibility to review any proposed public facility extension, modification, or other change with the City prior to engineering or other proposed design work to determine any special requirements or whether the proposal is permissible. A "Preliminary Review" and/or a "Plans Approved for Construction" stamp of the City on the plans, etc., for any job does not in any way relieve the engineer of responsibility to meet all requirements of the City or obligation to protect life, health, and property of the public. The plan for any project shall be revised or supplemented at any time it is determined that the full requirements of the City have not been met.

1.04 APPLICABILITY

These Design Standards shall govern all construction and upgrading of all public and privately financed public facilities in the City and applicable work within its service areas.

1.05 STANDARD SPECIFICATIONS

Except as otherwise provided by these Design Standards, all construction design detail, workmanship, and materials shall be in accordance with the current edition of the City Construction Standard Specifications and Standard Details.

1.06 APPROVAL OF ALTERNATE MATERIALS OR METHODS

Any substitution material or alternate method not explicitly approved herein will be considered for approval as set forth in **Section 1.01**. Persons seeking such approvals shall make application in writing. Approval of any major deviation from these Design Standards shall be in written form. Approval of minor matters shall be made in writing if requested.

Any alternate must meet or exceed the minimum requirements set in these Design Standards.

The written application is to include, but is not limited to, the manufacturer's specifications and testing results, design drawings, calculations, and other pertinent information.

Any deviations or special problems shall be reviewed on a case-by-case basis and approved by the Engineer. When requested by the Project Manager, full design calculations shall be submitted for review with the request for approval.

1.07 SPECIAL DESIGN PROBLEMS

Special applications not covered in these Design Standards require review and approval by the City. Submittal of full design calculations, supplemental drawings, and information will be required prior to any approval.

Such applications that may occur requiring special review and approval include, but are not limited to, the following:

- Energy Dissipaters
- Internal Sealing of Existing Sewers
- Relining of Existing Sewers
- Relining of Existing Water Mains
- Sewage Pump Stations
- Sewage Treatment Plants
- Sewer Flow Measurement/Monitoring Devices
- Sewer Force Mains
- Sewer Regulatory Devices
- Sewer Siphons
- Water Distribution Pump Stations
- Water Flow Measurement/Monitoring/Telemetry Devices
- Water Pressure Regulating Devices
- Water Reservoirs
- Water Treatment Plants

1.08 REVISIONS TO DESIGN STANDARDS

It is anticipated that revisions to these Design Standards will be made from time to time. The date appearing on the title page is the date of the latest revision. Users should apply the latest published revision to the work contemplated.

Parenthetical notations at the bottom of the pages indicate the most recent change to these sections. It shall be the user's responsibility to maintain his/her copy of these Design Standards with the latest changes.

SECTION TWO – GENERAL TECHNICAL

2.01 CONSTRUCTION PLAN GENERAL INFORMATION

Prior to any construction work and plan approval, complete construction plans, specifications, and all other necessary submittals and submit to the Project Manager for review.

2.02 CAD DRAFTING STANDARDS

2.02.01 General Guidelines

The City of Gresham Drafting Standards were developed to provide guidance to both the manual and CAD-based drafter although the majority of the documents deal with CAD-related issues. The increased use of CAD in the public and private sectors and the use of differing sets of standards necessitated their development. Particularly, problems arise in the transfer of CAD files from and/or to other organizations. It is hoped that these standards will improve the consistency of preliminary plans, construction plans, and as-built drawings. These standards address many of those routine questions that arise during the design and drafting stages of developments within the corporate limits of the City.

The intent is to present the design in a form that can be understood and constructed. The user of the drawing depends upon it to understand the idea accurately. Another purpose of the drawing, especially related to CAD work, is the possibility of data retrieval and reuse. If CAD-based drawings are built in a standard way, data can be extracted for use in other applications such as databases, estimates, proposals, and other drawings. This is a major consideration when using CAD. Remember, the data entered into a CAD drawing has possibilities far beyond the drawing itself.

2.02.02 CAD Criteria

CAD files submitted to the City shall be either AutoCAD 2002 .dwg files or .dxf files that can be imported directly into AutoCAD 2002 or later. Format is subject to change per annual review. All CAD files submitted to the City must conform to the City's layering. CAD files submitted as .dxf files shall be capable of maintaining the City's layering standards after translation to AutoCAD 2002 or later. All CAD files submitted to the City must be accompanied by the following City of Gresham documentation records:

	Title	Description
1.	Plotting list	Listing of all plotted sheets and source drawing files
2.	Reference file list	Parent/child listing of all external referenced drawing files used in the project
3.	Drawing assembly listing	Instructions/order for all referenced or inserted drawings
4.	Non-standard drawing list	Listing of all non-standard drawings used in the project
5.	Non-standard layer list	Listing of all non-standard layers used in the project
6.	Drawing checklist	Checklist of City drawing submittal requirements

2.02.03 Prototype Drawing Files

All CAD files submitted to the City shall be prepared using the City's CAD prototype drawing file – an AutoCAD 2002 drawing file named COGPROTO.dwg. The prototype drawing files and associated documentation are found in the "CAD Standards" folder that is included in the CD version of the Public Works Standards. It can be obtained from the Department of Environmental Services (DES). It may be converted to other CAD formats provided that the CAD files submitted to the City are capable of maintaining the prototype drawing appearance after being imported back into AutoCAD 2002 or later. COGPROTO.dwg contains the following:

1. City title block and attributes (in paper space)
2. City cover sheet example
3. Plan and profile title block
4. Standard text styles
5. Symbols library title block
6. General layers
7. COG.ctb plot file

2.02.04 Electronic Acceptance Standards

Purpose – All as-built construction drawings shall be submitted in accordance with **Section 2** of these Design Standards. This section outlines electronic standards, layering conventions, and sheet layouts. Electronic file format shall be compatible with the AutoCAD version accepted by the City. Files submitted shall adhere to the following minimum standard:

1.	All electronic files submitted must be generated with e-transmit command of AutoCAD.
2.	Layering protocols (layering system)
3.	List of layers
4.	All electronic files submitted for submission files should be zipped or be accompanied by a separate support folder that contains the following:
a.	Company's *.ctb that controls the plotted pens weights; default*.ctb's (acad.ctb, grayscale.ctb, etc.) are unacceptable if they have been modified; if the *.ctb has been altered in any way, it will need to be renamed intuitively.
b.	All Xref's file paths should be detached.
c.	Bind all Xref's in the *.dwg.
d.	All fonts should be standard in the *.dwg.

Accuracy – All as-built drawings shall accurately represent as-built construction and shall be graphically and mathematically correct, i.e., drawing shall represent changes in dimensioning during construction. Drawing shall also adhere to requirements in **Sections 1 and 2** of these Design Standards.

Consistency Between Electronic Copy and Hard Copy – (1) Submit all information required to reproduce a hard copy from the electronic file. The electronic copy and the hard copy shall be identical with the exception of the original signature of the signature on the engineer's stamp. (2) Use only standard AutoCAD line types, fonts, and shapes. If the City encounters significant problems during reproduction, the drawing shall not be accepted.

Electronic As-built Drawing Set – Submit a complete electronic as-built drawing set. This drawing set shall include, but not be limited to, a design drawing model and all contract drawing sheets. The electronic as-built drawing set shall conform to the minimum standards specified in this section.

1.	Plan and Profile:
a.	All infrastructure components shall be placed on the appropriate layers as described in the layering conventions. See the Layer Naming Convention chart and the Layer List in the CAD Standards folder for reference.
b.	In the plan section of the drawing, submit all infrastructure components in model space. Drawing objects not directly tied to the model and/or sheet-specific information may be placed in model or paper space.
c.	In the profile, detail, and cross section, all infrastructure components not directly tied to the model may be placed in model space or paper space and shall be placed on the appropriate layers as described in the layering conventions. See the Layer Naming Convention chart and the Layer List in the CAD Standards folder for reference.
d.	All specific construction notes shall be placed in model space. General construction notes may be located in either model space or paper space.

e.	Non-referenced images, standard drawings, specifications, and/or blocks shall be embedded in the drawing and not attached as an external reference.
f.	If registered orthophotography is used as a backdrop, the image and registration file, along with directory information, shall be provided.
2. Plot Layout/Plot Settings:	
a.	Submit all information required to reproduce a hard copy from the submitted electronic file in the standard City title block.
b.	Standard AutoCAD font and line types shall be used. If unsure, place drawing objects in model space on a unique layer.

Reference Information – (1) If Xref's are used with a drawing, bind all Xref's before submission. The City will not accept drawings with Xref's. (2) Purge all invisible drawing objects before submission.

Layering Conventions – All drawing components shall be placed on the correct layer as described in the layering protocols and conventions. See the Layer Naming Convention chart and the Layer List in the CAD Standards folder for reference. The layering protocols are to assist users with correctly developing layer names that will consistently meet the City's layering convention standards. All drawing components shall comply with these conventions.

Media – Files submitted shall be on a CD ROM or other storage media approved by the Engineer. Clearly label all media with City project number, project name, file name and extension(s), AutoCAD version, and date.

City Inventory Information – This information is needed to update City inventories and databases. When applicable, drawing content shall include this information and each item shall be placed on the appropriate layer as defined in the layering conventions. See the Layer Naming Convention chart and the Layer List in the CAD Standards folder for reference.

2.02.05 Plan Sheet Sizes, Layouts, and Format

Construction plans and specifications shall be stamped by a professional engineer licensed in the State of Oregon.

Drawings shall be, except as noted below, ANSI "D" size (22-inch by 34-inch) sheets. Title blocks are supplied by the City of Gresham.

Draw the plan so the north arrow is prominent and towards the top (long side) or left of the sheet whenever possible.

Scales: Different standards, other than the 2 listed below, may be used as approved by the Manager:

Plan/Scale	Horizontal	Vertical
Street	1" = 20'	1" = 2'
Sewer	1" = 40'	1" = 4'
	1" = 50'	1" = 5'
Storm	1" = 40'	1" = 4'
Water	1" = 20'	1" = 2'
	1" = 40'	1" = 4'

Complex utility locations may require a larger scale plan to show the necessary detail. If a scale is indicated on a plan sheet, a bar scale shall be used.

Provide match lines with matched sheet number where the plan is drawn on more than one sheet. If the plan is shown on three or more sheets, include a site plan key map at a common scale of 1" = 100' or 1" = 200' or representative fraction of 1:1200 or 1:2400.

Section and detail call-outs are shown on both the plan and the section/detail. They should include assigned section/detail letters/numbers and drawing sheet location number.

Final plans shall be submitted using the standard City of Gresham title block. The electronic digital drawing file shall accompany the submission. The City of Gresham title block (AutoCAD 2002 or later drawing file format) can be found in the CAD Standards folder on the Public Works Standards CD and can be obtained from the City's Department of Environmental Services.

Plans must be of such quality that when reduced to 50% of original scale the prints will be clearly legible.

Plan Sequence – Use the following sequence for the applicable sheets for design and as-built plans:

1. Cover Sheet – Site Plan Key Map
2. Symbols and Abbreviations
3. Plat Sheet
4. Composite Utility Drawing
5. Grading and Erosion Prevention & Sediment Control (EPSC)
6. Grading and EPSC Details and Notes
7. Street and Storm Plan and Profile
8. Offsite Street and Storm Plan and Profile
9. Street and Storm Details and Notes
10. Sanitary Sewer and Water Plan and Profile
11. Offsite Sanitary Sewer and Water Plan and Profile
12. Sanitary Sewer and Water Details and Notes
13. Streetlight Plan (may be included on composite utility drawing)
14. Traffic Control Plan
15. Standard Details and Notes

An index is to be included on the cover sheet of all plan sets using the titles as they appear on the plan sheet(s).

The vicinity map needs to show the locations and limits of the project and specify scale.

Plan and profile shall be placed on the same sheets. The horizontal scale of the profiles shall be the same as that on the plan.

Required Information – The following items shall be contained within the City of Gresham title block aligned vertically along the right side of each sheet:

- a. Project title
- b. Sheet title
- c. Designer's company/agency information – name, address, voice/fax telephone numbers, e-mail address, logo, etc.
- d. Engineer's stamp and signature
- e. Review stamp (if applicable) – When plans are submitted to the City for review and comment, the plans shall be clearly marked "PRELIMINARY – NOT FOR CONSTRUCTION" over the engineering stamp and signature.

- f. Date of drawing
- g. Revision block – including area for revision number, description, date, and name
- h. Project name, date, time, and file name and project number – orientated vertically near the bottom left hand corner of the sheet
- i. “City Approval” (blank area for City approval stamp and signature by the Engineer)

Submittals shall contain the following sheets: title sheet (unless not required by the Engineer), plan and profile sheet(s), Standards Checkoff Sheet (see CAD Standards folder), and detail sheet(s).

Drafting Requirements:

1. Plan sheets may be plotted from CAD files using industry standard output devices.
2. Minimum lettering size is 0.10-inch (metric size needed) to ensure legibility after reduction to one-half size. Lettering and dimensioning shall be placed so they may be read from left to right as viewed from the bottom of the sheet and from bottom to top when viewed from the right side of the sheet. Text should be clear of any lines.
3. No stick-on's are to be used on final plan sheets.
4. Existing features and topography shall be shown with sufficient density to adequately reproduce at a 50% reduction of scale.
5. All existing and proposed improvements shall be referenced to the City of Gresham Photogrametric Control Network and conform to Multnomah County Surveying Standards.
 - a. For survey reference, improvement project coordinate values are based on the Lambert State Plane Coordinate System, Oregon North Zone. Basis of bearing for all measures shall be taken from the City Photogrametric Control Network.
 - b. All vertical survey measurements and elevations shall be made with reference to the vertical datum as defined in *Subsection 1.02*.
 - c. Horizontal and vertical control stations used as a basis of project control shall be prominently provided on the cover sheet.
6. Existing and proposed topography contours shall cover the entire site and, whenever practicable, a minimum of 50-feet beyond the site boundary. Existing topography should be screened. Topography contour intervals shall be shown at:
 - 2-foot for slopes less than 10%
 - 2-foot for slopes between 10% and 40%
 - 5-foot for slopes greater than 40%.
7. All division or phase lines shall be indicated showing proposed limits of construction.
8. Label all streets with City of Gresham names.
9. All final design sheets shall include the professional engineer's seal, signature, address, and phone number placed in the title block area as shown on City of Gresham sample Title Block Sheet in the CAD Standards folder.

2.02.06 City of Gresham Prototype Drawing Files

All CAD files submitted to the City shall be prepared using the City's CAD prototype drawing file, an AutoCAD 2002 drawing file named COGPROTO.dwg and located in the CAD Standards folder on the Public Works Standards CD. The prototype-drawing file can be obtained from the City's Department of Environmental Services. It may be converted to other CAD formats provided the CAD files submitted to the City are capable of maintaining the prototype drawing appearance after being imported back into AutoCAD 2002 or later.

COGPROTO.dwg contains the following:

1. City title block and attributes (in paper space)
2. Standard text styles
3. Gridline block for plan and profile drawings north arrow block
4. General layers
5. Symbols library drawing

2.02.07 Text Styles

All .dwg CAD files submitted to the City shall use the following native AutoCad 2002 text fonts. CAD files submitted as .dxf files must emulate these styles. No custom or proprietary fonts shall be submitted without prior approval. Use ROMANS as the primary font. Minimum plotted height is 0.10-inch on "D" size drawing. The maximum oblique angle allowed is 8°. Use only 0 or 8°.

Application – The City requires the "STANDARD" text style be used in the following instances:

- Text notes used for information regarding
 - Benchmark locations
 - Notification contacts
 - General and erosion control construction notes
- Construction notes on plan/profile drawings
 - Text used in details
 - Attention to utility conflicts
 - Connection to existing facilities
 - Identification of topographical features
 - A notation referencing details, sections, sheets in bubbles, etc.
 - Existing and proposed utility identification
 - Utility feature
 - Size of diameter
 - Material
 - Slope
 - Privately maintained conveyance
 - Dimension text styles
 - Custom created detail notes, dimensions, text, etc.

These are some of the instances you would use the "STANDARD" text style, but certainly not all. Minimum plotted text height of all text must be .10-inch when plotted for submittal on the 22-inches x 34-inches City title block.

2.03 REQUIRED SHEET INFORMATION

Construction plan submittals shall contain the following minimum sheets: Title Sheet (unless not required by the City), Composite Utility Plan, Erosion Prevention & Sediment Control, and Tree Removal Plan.

2.03.01 Title Sheet

All subdivision projects and multiple sheet improvement projects shall have a title sheet as the first page of the construction plans. This sheet shall contain the following minimum information:

- a. Site plan of entire project with street right-of-way and/or subdivision layout at a 1" = 100' scale. A 1" = 200' scale may be used if project size is too large. The site plan shall also be a composite utility plan showing all properties served by proposed sewer, water, and storm facilities, in addition to the proposed facility.
- b. Vicinity map at a 1" = 1000' scale or greater.
- c. Index of sheets.
- d. Complete legend of symbols used.
- e. General and construction notes pertinent to project.
- f. Datum, as defined in *Section 1.02* and temporary and/or permanent benchmarks used along with their descriptions, and elevations of benchmark.
- g. Engineer's name, address, phone number, and seal.
- h. Developer's/owner's name, address, and phone number for privately financed public improvements.
- i. Statement referencing City of Gresham Standard Specifications.
- j. Provide contact phone number for all affected utility companies and pertinent City personnel.
- k. Show tax lot numbers or lot and block designations.

2.03.02 Erosion Prevention & Sediment Control and Tree Removal Plan

The erosion control plan shall address the measures as required by the City's Erosion Prevention & Sediment Control Manual (EPSC). Construction projects anticipating construction activity between October 1st and May 31st will be required to submit a plan addressing "wet weather" measures as outlined in the EPSC Manual. Construction activity is assumed as "active" until permanent vegetation and/or erosion protection is established.

The plan shall include existing contours at 2-foot intervals or as approved by the City, including location of erosion control facilities (e.g., silt fence, straw mulch, sediment ponds, etc.); inlet and outlet structures (e.g., catch basins, culverts, creeks, etc.); and existing public and private utilities.

All trees with 8-inch and larger diameters shall be shown on the plan. The plan shall identify the location, caliper, and species of the tree and shall indicate if the tree is proposed to remain or to be removed.

2.03.03 Plan Sheet

All plans shall use elevations based on the datum as defined in *Section 1.02*.

The plan view of each sheet shall be drawn at the appropriate scale showing the following minimum information:

- a. Adjacent street curbs, property lines, right-of-way lines, utility easements referenced to property lines, street centerlines, and intersections. Show property corner and curb elevations to determine water service level, serviceability of lot/property for sanitary sewer, points of disposal for building storm drains, and how new curbs will join to existing curbs.
- b. Location of all underground utilities within 100-feet of project (if they are affected by the project), existing power/telephone poles and guy anchors, valves, manholes, catch basins, fire hydrants, meter boxes and vaults, signs, etc.
- c. Location of all water courses, railroad crossings, culverts, bridges, large water transmission pipes and wastewater systems, and/or storm drains within 200-feet of proposed wastewater system and storm drain extensions if they affect the design of the project. All watercourses shall show the 100-year flood plain as indicated on the U.S. Army Corps of Engineers and Federal Emergency Management Agency (FEMA) maps.
- d. On wastewater and storm drain plans, each manhole, catch basin, and cleanout shall be numbered and stationed. Stationing shall tie to existing street monuments, property corners, or manholes. Each line shall be stationed continuously on the plan sheet. Each separate line shall be separately designated (e.g., wastewater line "A", storm line "A", etc.).
- e. On plat sheet, horizontal stationing shall show points of tangency and curvature for centerline; curve data shall show tangent length, radius distance, centerline curve length, and delta angle. Centerline intersection stationing, in both directions, shall be shown.
- f. Where streets are being widened, edge of pavement elevations shall be shown to determine pavement cross-slope to new curb or pavement edge.
- g. On water plans, all fittings and valves shall be shown and identified by type (i.e., MJ x MJ, FLG x MJ, etc.); fire hydrants shown; intersection details for valves and fittings are required when scale of plans is smaller than 1" = 20' (i.e., 1" = 40').
- h. Where elevation contours are shown, they shall use elevations based on the datum as defined in **Section 1.02**.

2.03.04 Profile Sheet

All profiles shall use elevations based on the datum as defined in **Section 1.02**.

Profiles for construction plans shall be the same horizontal scale as the plan sheet. Where profiles are drawn on the same sheet as the plan view, the profile shall be immediately below the plan view. Stationing shall be continuously upgrade from left to right with lower stations to the left. The following minimum information shall be shown:

- a. For waterlines, show all locations of fittings, valves, and fire hydrants with each having size and stationing call-outs.
- b. For wastewater systems and storm drains, show locations of manholes, catch basins, and cleanouts, with each numbered and stationed as indicated in **Subsection 2.03.03d**.
- c. Existing profile at centerline of proposed utility or street, plus, whenever practicable, 100-feet each direction from end of proposed street.

- d. Proposed profile grade, as appropriate, for all wastewater systems, storm drains, and waterlines, giving pipe size, length between structures or fittings, slope, backfill and pipe material, sewer inverts, rim elevations, etc.
- e. Existing and proposed underground utility that crosses the alignment of the proposed facility.
- f. Beginning of all vertical curves, points of vertical intersection, end of vertical curve, low point of sag curve, high points, and length of vertical curve. Whenever practicable, profiles of existing centerline grade shall extend a minimum of 250-feet beyond the end of the improvement.
- g. Clearly show all potential conflicts with existing public and private utilities (i.e., pipes, conduits, vaults, cathodic protection systems, etc.) that impact proposed design.

SPECIAL NOTE: City as-builts are only to be used as an aid to the Engineer of Record. When a potential conflict may occur, the Engineer of Record shall field locate, or cause to be located, and verify the alignment, depth, and inverts of all existing facilities shown on the plans that will be crossed by the proposed facility.

2.03.05 *Detail Sheets*

Standard Details shall be included on a separate sheet(s) with all construction plans. If a Standard Detail, such as sewer manholes, must be modified to fit existing or unique conditions, the modified drawing shall be marked accordingly on the detail. When appropriate due to required detail complexity or if a standard detail does not exist, a separate detail sheet shall be drawn.

2.04 *SUPPORTING INFORMATION*

The Engineer of Record shall submit sufficient supporting information to justify the proposed design. Such information shall include, but not be limited to, the following:

- a. Design calculations
- b. For storm drains, hydrology and hydraulic calculations with basin maps
- c. Alternate materials specifications including manufacturer's design application recommendation
- d. Grading plan support information to include as appropriate:
 - (1) Soils engineering report
 - (2) Hydrology report
 - (3) Engineering geology report
- e. A narrative of the stormwater facility, including its intended functionality, and an explanation of how the outlet(s) function to meet peak discharge control and water quality treatment control requirements
- f. Downstream analysis:
 - (1) An analysis shall be performed to determine the potential impacts from the project on the downstream system. At a minimum, the downstream analysis will include the area from the project site to a point, to be determined by the city, downstream of the project site. The analysis must proceed far enough along the drainage course to determine that nothing downstream of the end point will be adversely affected by the project's runoff. Refer to **Section 4.04**, Downstream Analysis Report, for a detailed description of how to perform a downstream analysis.
 - (2) For waterline systems, water model calculations

2.04.01 Facility Plan

When designing wastewater or stormwater sewer facilities, a facility plan shall be submitted with the construction plans when required by the Engineer. This plan shall be used to identify and analyze the proposed extension of facilities. Whenever practicable the topographic plan shall show all upstream and tributary areas within at least 200-feet of the proposed development.

The plan shall include existing contours at 2-foot intervals, or as approved by the City, including location of existing structures and public and private utilities.

2.04.02 Maintenance Plan

A maintenance plan shall be submitted for City review and approval for all privately financed private detention, retention, and water quality facilities. The plan shall include types and frequencies of maintenance activity required.

2.05 PLAN SUBMITTAL

Construction plans for all privately financed public improvements shall be submitted to the Project Manager. The Project Manager will coordinate the plan review and approval of all construction plans that will include review for compliance with all conditions of approval, Gresham Public Works Standards, the Gresham Community Development Plan, City Code, Ordinances, and any relative master plan.

All plan submittals shall include information required in **Section 2** of these Design Standards along with all other information requested by the Engineer. This information is to include, but not be limited to, construction cost estimates, easement documents, right-of-way dedications, executed agreements, and a plan check and inspection fee. All submittals will be reviewed for completeness and the Engineer of Record notified if required information is missing. Submittals should be made in a timely manner as lack of information to the City may impede the review process.

2.06 AS-BUILT PLAN REQUIREMENTS

For all public works improvements the Engineer of Record shall submit certified as-built drawings for all plans that were approved for construction within 3-months of the completion of construction. As-built drawings shall meet the requirements of **Sections 2.02, 2.03**, and this subsection and shall be of archival quality. At a minimum, the drawings shall be 4-mil mylar with permanent, UV resistant marking medium. Original inked mylars may also be submitted in lieu of photographic mylars.

The Engineer of Record shall be responsible for as-built surveying of the project to incorporate information including, but not limited to, ends of sewer laterals, manhole locations, and depths of pipes at manholes for inclusion in as-built drawings, and shall submit, along with the as-built drawings, a statement certifying that all work for which plans were approved has been completed in accordance with the Gresham Public Works Standards specifications.

The words "As-built Drawing" shall appear as the last entry in the revision block along with the month, day, and year the as-built drawing was prepared.

All sheets that were part of the original, approved design plan set shall be submitted as part of the as-built drawings, including title and detail sheets.

As-builts must include all private and public easement information.

NOTE: Actual location and depth from finish grade of any other utilities encountered during construction shall be shown and noted on both plan and profile of the as-built plans.

2.06.01 Street

The following minimum information shall be noted on street as-built drawings:

- a. Change in horizontal alignment, curve data, and stationing of primary control points (e.g., PC, PI, PT, PRC)
- b. Vertical curve or grade changes; change in location of low point in sag vertical curve
- c. Change to approved thickness for street structural section components. Show station limits where changes in structural section have occurred
- d. Change to driveway locations or widths
- e. Other change altering the approved plans

2.06.02 Storm Drains

The following minimum information shall be noted on storm drain as-built drawings:

- a. Station of connection into main line; tie end of branch line to nearest property corner at right-of-way line and distance back from the face of curb
- b. Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes, a station equation shall be shown as appropriate at a manhole
- c. Other change altering the approved plans

2.06.03 Wastewater

The following minimum information shall be noted on sanitary sewer as-built drawings:

- a. Station of wye or tee into main line; tie end of service lateral to nearest property corner at right-of-way line and distance back from the face of curb
- b. Depth at the end of service lateral measured from existing ground to invert of pipe; when required by the Engineer, invert elevations shall be noted
- c. Length of service lateral measured from centerline of sewer main to end of pipe
- d. Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes, a station equation shall be shown as appropriate at a manhole
- e. Other change altering the approved plans
- f. Provide complete test results to the Project Manager
- g. Type of pipe, backfill material, and location

2.06.04 Water Main

The following minimum information shall be noted on water main as-built drawings:

- a. Station and/or property line/corner to valves (not at standard location), all fittings, blow-offs, and dead-ended lines
- b. All changes from standard 36-inch depth cover; limits shall be shown on plan with annotated reason for change; actual pipe elevation (top of pipe) will be taken at every fitting that is not at standard cover
- c. Show alignment changes, grade changes, and changes in construction materials; if changed alignment results in station changes, a station equation shall be shown as appropriate at a fitting
- d. Provide manufacturer of all valves; identify types of fittings (e.g., MJ x MJ, FLG x MJ, etc.); provide information in the form of an inventory list on construction drawings
- e. Other change altering the approved plans
- f. Provide design calculations and complete test results to the Project Manager
- g. Actual location and depth, from finish grade of street, of any other utilities encountered during construction

SECTION THREE – WASTEWATER SYSTEMS

3.01 GENERAL DESIGN REQUIREMENTS

Performance Standards – Wastewater system design shall meet the policies and guidelines of the latest Sewerage System Master Plan and its updates.

Wastewater systems shall be designed to provide gravity service to all areas of development.

Wastewater system capacity shall be designed for ultimate development density of the contributing area. The system shall allow for future system extension and for future development based on current and on proposed land use designations.

Wastewater systems shall be designed to remove the domestic wastewater and industrial wastes from basements of houses where practical, commercial or industrial buildings, and all public and private establishments where possible.

Stormwater, including street, roof, or footing drainage, shall not be discharged into the wastewater system but shall be removed by a system of storm drains or by some other method separate from the wastewater system.

Unpolluted or non-contact cooling waters shall not be discharged into wastewater systems. The overflow drains and filter backwash lines of swimming pools and “hot tubs” shall drain into a wastewater system.

In general, wastewater systems shall be designed to allow for future loads and for ultimate development of the specific drainage area or basin based on current and on proposed land use designations.

As a condition of wastewater service, all developments will be required to provide public wastewater systems to adjacent upstream parcels in order to provide for an orderly development of the drainage area. This shall include the extension of wastewater mains in easements across the property to adjoining properties, and across and along the street frontage of the property to adjoining properties when the main is located in the street right-of-way. This shall include trunk lines that are sized to provide capacity for upstream development.

All public wastewater systems shall be located within the public right-of-way whenever possible. Under special topographical conditions, the placing of public wastewater systems outside of public right-of-way may be approved by the Engineer. When system access facilities such as manholes and cleanouts are constructed beyond access from the roadway, a heavy vehicle accessway shall be provided as shown in Standard Detail 605.

Design shall comply with Oregon Department of Environmental Quality sewer design guidelines, **OAR 340, Division 52**.

For any project requiring construction within or adjacent to watercourses and/or wetlands, in addition to approval by the City, permits from the appropriate responsible agencies (Oregon Department of Fish and Wildlife, Oregon Division of State Lands, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, etc.) shall be obtained. Copies thereof, or written evidence that no permit is required, shall be given to the City prior to any clearing or construction.

3.01.01 Wastewater Plans

In addition to the requirements of **Section 2** of these Design Standards, the following requirements shall apply to plans for public wastewater system improvements: Whenever practicable the plan and profile sheets shall show the topographic information required by **Subsection 2.04.01** for a minimum of 200-feet upstream of the proposed end of any extendable mainline sewer.

3.01.02 Pipe Materials and Size

All public wastewater systems shall be constructed with ASTM D-3034, SDR35 PVC pipe as specified in **Section 301** of the Construction Standard Specifications. Where required for added strength, AWWA C-900, or AWWA C-905, PVC Pipe, or ASTM C-76 reinforced concrete pipe shall be used. Class 50 ductile iron pipe will be used when added strength is needed and pipe wall thickness is limited.

Solid wall HDPE pipe may be used in boring, jacking, pipe bursting, and other similar applications when approved by the Engineer. Private sanitary sewers shall meet the appropriate sections of the Uniform Plumbing Code.

All public wastewater main lines shall be a minimum diameter of 8-inches.

3.01.03 Minimum Design Criteria

Design Values – If there are no specific project values for the amount of sewage to be generated (Uniform Plumbing Code flows), the following design values shall be used:

Land Use Designation	Net Density (Dwelling Units/Acre)	Net Population (People per Acre)	Daily Wastewater Flow (Gallons/Day/Acre)
LDR	8.71	19.2	1,533
TLDR	20.00	44.0	3,520
MDR-12	12.10	26.6	2,130
MDR-24	24.20	53.2	4,259
OFR	12.10	26.6	2,130
Gresham Butte Overlay	1.00	2.2	176
BP	1.00	2.2	176
LI	2.18	4.8	384
HI	2.18	4.8	384
NC	4.36	9.6	767
GC	4.36	9.6	767
RTC	40.00	88.0	7,040
SC	60.00	132.0	10,560
SC-RJ	60.00	132.0	10,560
CMF	24.00	52.8	4,224
CMU	24.00	52.8	4,224
CC	40.00	88.0	7,040
MC	40.00	88.0	7,040
CUC	60.00	132.0	10,560
DT	60.00	132.0	10,560
DR-12	12.00	26.4	2,112
DR-30	30.00	66.0	5,280
DC-1	30.00	66.0	5,280
DC-2	30.00	66.0	5,280
TDM-C	60.00	132.0	10,560
TDH-C	60.00	132.0	10,560
HDR-C	60.00	132.0	10,560
MDR-C	30.00	66.0	5,280

In addition to the wastewater flows in this table, an allowance of 1,000-gallons/day/acre shall be added for all the land area in the basin being served to account for inflow and infiltration (I & I).

A peaking factor shall be applied to the daily wastewater flow. The peaking factor shall be 3.0.

The wastewater design flow in gpd is then calculated as: Acres * (1,000 + DWF * 3.0) where DWF = Daily Wastewater Flow in gpd/acre from table above.

Velocity – All wastewater pipes shall be designed at a grade that produces a mean velocity of the wastewater design flow of no less than 2-feet per second and not more than 15-feet per second. If topography requires a grade that would result in a velocity greater than 15-feet per second in one pipe section, additional drop manholes shall be installed as required by the City.

The velocity shall be calculated using the wastewater design flow for the basin to be served now and at ultimate design flow in the future.

Size – The pipe size shall be based on the minimum size needed for the design flow and not the size needed to result in a desired slope. The pipe size shall be determined by using one-half of the maximum gravity flow capacity of the pipe for pipes 15-inches in diameter and less, and shall be two-thirds for pipes larger than 15-inches in diameter.

The Engineer of Record shall submit his calculations for each wastewater line to be installed, exclusive of sewer laterals. Such calculations shall include the requirements of **Subsection 3.0010** herein before.

Manning's Equation – When calculating volumes, slopes, and velocities, the Engineer of Record shall use the Manning pipe friction formula.

$$V = (1,486/n) * (R^{(2/3)}) * (S^{(0.5)})$$

Where: V = Q/A = 2 ft./Minimum 1 sec
n = 0.013 Minimum
R = Hydraulic Radius, ft
S = Slope, ft/ft

Minimum Slope – For verification purposes the following table of minimum pipe slopes shall be used. The slopes shown are for informational purposes only. The actual slopes shall be determined by the actual wastewater design flow.

Pipe Size (Inches)	Slope (Feet/Feet)
6	0.00490
8	0.00334
10	0.00248
12	0.00195
15	0.00145
18	0.00114
21	0.00093
24	0.00078
27	0.00066
30	0.00058
36	0.00045
42	0.00037
48	0.00031
54	0.00027
60	0.00023
66	0.00020
72	0.00018

Pipes with slopes of 20% or more, while having to conform to the maximum velocity requirements specified above, are required to have anchor walls as detailed in the Standard Detail 321.

3.02 ALIGNMENT AND COVER

3.02.01 Right-of-way Location

Wastewater lines shall be located 5-feet north or west of the right-of-way centerline.

Wastewater systems shall be located in the street right-of-way. If streets have curved alignments, the center of the manhole shall not be less than 6-feet from the curb face.

Curved alignments in wastewater systems, vertically or horizontally, are not permitted.

3.02.02 Minimum Cover

All wastewater pipes shall be laid at a depth sufficient to drain building sewers to protect against damage by frost or traffic and to drain basement sewers where practical. Sufficient depth shall mean the minimum cover from the top of the pipe to finish grade at the wastewater alignment. In new residential hillside subdivisions, mainline and sewer laterals shall be placed in the street at a depth sufficient to drain building sewers on the low side of the street.

Wastewater pipes in residential areas shall be placed with the following minimum cover:

Building Service Branch	– 6-feet at right-of-way for level or upward sloping lots
Trunk and Collector Sewer	– 9-feet in roadways and easements

C-900, C-905, or ductile iron pipe shall be used in accordance with **Subsection 3.01.02** when cover is less than 3-feet from subgrade.

Where the topography is relatively flat and existing sewers are shallow (5-feet or less), the minimum cover shall be 3-feet.

Deviation from the above standards will be considered on a case-by-case basis when one of the following circumstances exist:

- a. Underlying rock strata – required submittal: A request in writing to the Engineer, together with submittal of a soils report, with a plan and profile certifying that bedrock exists 3-feet below the undisturbed ground surface at all investigated alignments.
- b. A ditch or stream must be crossed – required submittal: A plan and profile; horizontal scale 1-inch = 20-feet, vertical scale 1-inch = 2-feet.

3.02.03 Separation with Waterlines

Water mains shall be installed a minimum clear distance of 5' horizontally from wastewater pipes and shall be installed to go over the top of such pipes with a minimum of 18" of vertical clearance at the crossing of these pipes (in accordance with the requirements of OAR Chapter 333, Public Water Systems). Exceptions shall first be approved by the Engineer. In all instances the distances shall be measured surface to surface.

Where individual properties are served by private pumps and force mains discharging to a public wastewater system at the property line and a domestic water well is also on that same property, either Uniform Plumbing Code (for water systems servicing 3 or less dwelling units) or State Health Department (for community water systems servicing 4 or more dwelling units) specified separation of wastewater and waterlines shall apply.

3.02.04 Easements

When, in the Engineer's opinion, it is impractical to locate City utilities in rights-of-way, the utilities shall be placed in an easement. All public utility easements granted to the City shall be perpetual easements.

All easements shall be exclusive to a single City utility unless otherwise approved by the Engineer.

The conditions of the easement shall be such that the easement shall not be used for any purpose that would interfere with the unrestricted operation and maintenance of the utility. Under no circumstances shall a building or any other structure be placed over a utility or utility easement. This shall include overhanging structures with footings located outside the easement.

Easement locations for public utility facilities serving a PUD, apartment complex, or commercial or industrial development shall be in parking lots, private drives, or similar open areas that will permit an unobstructed vehicle access for maintenance.

Except with approval of the Engineer, easements shall be placed on a single property, not centered on property lines, and the utility shall be centered in the easement. If an easement centered along a property line is approved by the City, the utility shall be offset 18-inches from the property line.

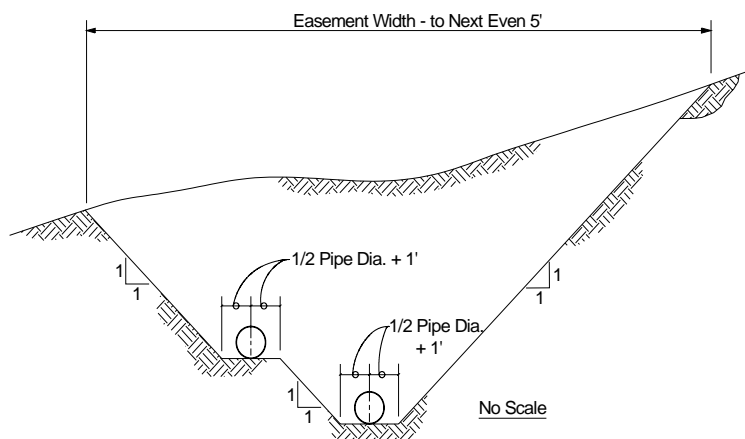
All easements must be furnished to the Engineer for review and approval prior to recording and the start of construction.

Easement location, purpose, width, and description shall be shown on the plans.

Minimum width of a public utility access easement shall be 15-feet.

Minimum width of a public utility easement shall be 20-feet. Easement width shall be determined by multiplying the vertical distance from the pipe invert to the ground surface by 2, then adding the nominal pipe diameter plus 2-feet. Easement width shall be rounded upward to even 5-foot increments, but in no case shall be less than 20-feet. In areas of steel (15% slope or greater) or unusual topography, a wider easement may be required as determined by the Engineer.

For multiple utilities to be located within the same easement, the same above rules apply except that the separation of the sewers, both horizontally and vertically, must be considered. Utilities must have at least a 1-foot horizontal separation of the outside surfaces, including bells. For multiple utilities at differing elevations, the horizontal separation and easement width is determined as shown below:



3.02.05 *Relation to Watercourses*

Generally, the top of all wastewater pipes entering, crossing, or adjacent to streams shall be at a sufficient depth below the natural bottom of the streambed to protect the line. One-foot of cover is required where the wastewater line is in rock; 3-feet of cover is required in other materials. In paved channels, the top of the wastewater line shall be placed at least 6-inches below finish grade of the bottom of the channel, except as provided above.

Wastewater lines located along or parallel to streams shall be located outside of the streambed and sufficiently removed therefrom to provide for future, possible stream channel widening. All manhole covers at or below the 100-year flood elevation shall be watertight.

Wastewater lines crossing streams or drainage channels shall be designed to cross the stream as nearly perpendicular to the stream channel as possible. The minimum cover shall be 36-inches from the bottom of the streambed or drainage channel to the top of pipe.

The pipe material shall be C-900, C-905, or ductile iron in accordance with **Subsection 3.01.02**, or continuous high-density polyethylene with an 18-foot length of pipe centered on the stream or drainage channel centerline. The specified pipe type shall extend to a theoretical point where a one-to-one slope begins at the top of the bank and slopes down from the bank away from the channel centerline and intersects the top of the pipe.

Concrete encasement per Standard Detail 322 will be required when the above cover requirements cannot be met. Each deviation from the above requirements will be reviewed by the Engineer on a case-by-case basis.

3.03 STRUCTURES

3.03.01 Manholes

Manholes shall be located at all changes in pipe slope, alignment, size, type, and at all pipe junctions with present or future wastewater lines excluding 4" or 6" service branches serving 4 or fewer living units.

Manhole spacing shall not be greater than 500-feet.

The Standard Details are suitable for most conditions. New designs or revisions should not be shown on the construction drawings unless the standard designs are not suitable. New or revised designs may be necessary if:

- a. One or more of the sewers to be connected to the manhole is over 27-inches in diameter (smaller diameters may require a special design if the manhole is at an alignment change)
- b. Several sewers will be connected to the manhole
- c. There is less than 90° between the incoming and outgoing sewer
- d. The manhole will be subject to unusual structural loads
- e. Diversion or other flow control measures are required

Where one or more of conditions a, b, or c are encountered, a drawing of the manhole base shall be made to determine if it is feasible to use designs shown in the Standard Details. It may be necessary for the Engineer of Record to restrict the manhole options to a specific Standard Detail specified by a note on the construction drawings. If a special design is required for any reason, it will be necessary to show that design on the construction drawings and to provide the Project Manager with structural calculations.

Some alternate manhole features are shown in the Standard Details. Where these features are required, they must be specified by a note on the construction drawings. Some examples are:

- a. Slab tops must be used in lieu of cones where there will be less than 4-feet between the top of pipe and the top of the manhole lid.
- b. Watertight manhole frames and covers are to be used if floodwaters are expected to cover the manhole top or if the manhole must be located in the street gutter. Such conditions should be avoided wherever feasible.

- c. Tamperproof manhole frames (7-inch depth) and covers are required in all areas outside the paved public right-of-way.

Standards for elevation differences at manholes have been established to compensate for normal energy losses and to prevent surcharging of the wastewater system. For purposes of slope calculation and for establishing elevation differences, the elevations are given at the theoretical horizontal intersection of the wastewater centerlines (usually the center of the manhole). The rules for elevation differences at manholes are:

- a. The crowns of incoming pipes shall be at least as high as the crown of the outgoing pipe.
- b. If the incoming and outgoing pipes are of equal size and are passing straight through the manhole, no added elevation change is required.
- c. If the pipe alignment changes at the manhole, the invert elevation difference shall be at least 0.10-feet for 0° – 45° of horizontal deflection angle, and 0.20-feet for 45° – 90° of horizontal deflection angle. Horizontal deflection angles of greater than 90° are not allowed.
- d. Drop connections are required when the vertical distance between flow-lines exceeds 2-feet.
- e. All connections must enter the manhole through a channel in the base. This includes drop connections and connections to existing manholes.

Where conditions make compliance with these rules impractical, exceptions will be permitted. It will be necessary, however, for the Engineer of Record to provide a complete analysis of the need for such designs.

3.03.02 Cleanouts

Cleanouts will not be approved as substitutes for manholes on public wastewater lines. Cleanouts are permitted at the upper end of a wastewater line that is designed to be extended during a future phase of construction. If future extension requires a change in pipe slope, alignment, size, or type, a manhole will be required at the cleanout location.

Cleanouts are permitted at the end of a non-extendable sewer line that does not exceed 250-feet in length nor serve more than 8 lots.

3.04 SEWER LATERALS

Sewer laterals are those public wastewater lines to which a private building sewer connects.

Each individual building lot shall typically be connected by a single, separate, private, building-sewer/sewer lateral line connected to the public wastewater system. Individual sewer laterals shall be located no closer than 10-feet to the property line. Combined (Siamese) wastewater service branches for 2 lots will be permitted only when each property cannot legally be further divided and it is in the best interest of the City to do so. See Standard Detail 318.

The minimum nominal diameter of a sewer lateral shall be 4-inches. In all cases the sewer lateral shall be equal to or greater than the building sewer diameter. Sewer laterals shall be built to the same construction standards and of the same materials as the wastewater main line. Sewer laterals in general shall be placed at 90° to the wastewater main line to avoid excessive exposure to other utilities during excavation for construction or maintenance of the sewer laterals. Angles other than 90° (45° minimum) may be approved by the Project Manager for cul-de-sac lots. Sewer lateral connections may be made at manholes if such placement would not interfere with other present or future connections to the manhole.

The minimum slope of sewer laterals shall be 2%. Except that for unusual conditions, a slope of 1% may be approved. It will be necessary, however, for the Engineer of Record to provide a complete analysis of the need for any sewer lateral slope less than 2%. The maximum slope shall be 100% (45°). Connections to deep wastewater main

lines shall be made with risers (see the Standard Detail 316). Alternately, drop connections into manholes must be used where sewer lateral slopes would exceed 100%.

3.05 CONNECTION TO EXISTING SEWERS

Connections to and extensions of existing wastewater systems will occur to facilitate new development. Certain requirements will be placed on the Engineer of Record as to permitted methods and/or locations.

Connections to existing manholes shall be made with the following guidelines:

- a. Where the invert of the connecting pipe is 2-feet or less above invert of the outgoing pipe, the sewage entering the manhole will follow a smooth concrete channel transitioning evenly from the invert of the inlet pipe into main channel. Sewage will not be allowed to fall freely to the manhole base.
- b. Where the invert of the connecting pipe is more than 2-feet above the invert of the outgoing pipe, the Contractor will be required to construct an inside drop per Standard Detail 304 for pipes 15-inches and smaller. Drops for larger pipes will not be allowed. Wastewater entering the manhole will follow a smooth concrete channel transition from the bottom of the drop into the main channel.
- c. Where the invert is required to enter below the shelf of the manhole, the inlet pipe will not enter below a point where the crown of the new inlet pipe is below the crown of the outlet pipe. The base of the manhole will be rebuilt if damaged in this process. The wastewater flow shall enter the main flow in a smooth channel transitioning from the inlet pipe to the main channel.
- d. No pipe will enter an existing manhole where the angle between the incoming flow and the outgoing flow is less than 90°.

3.06 PRIVATE SEWER LINES

Private sewer lines shall be installed on private property in accordance with the requirements of the Uniform Plumbing Code.

Easements for private sewer lines are the responsibility of the owners; but copies of the recorded easements must be given to the Project Manager prior to any construction.

Private sewer lines shall not be permitted within the public right-of-way.

3.07 SUBSURFACE DISPOSAL

Subsurface wastewater disposal is permitted only when connection to a public wastewater system is not practical as determined by the City. Contact the City of Portland, as the responsible regulatory body for questions and permits for subsurface disposal within the Multnomah County area.

3.08 WASTEWATER PUMP STATION DESIGN STANDARDS

3.08.01 General

The pump station shall be a submersible pump-type facility and shall generally conform to the plans and specifications for the City of Gresham Standard Submersible Pump Station. A copy of these documents may be obtained from the City's Wastewater Division. In addition, the design shall meet or exceed the minimum requirements of the Oregon Department of Environmental Quality (DEQ) as established in the Oregon Administrative Rules, Chapter 340, Division 52, and as presented in the DEQ publication "Oregon Standards for Design and Construction of Wastewater Pump Stations". Where conflicts exist between the Gresham Public Works Standards and

the aforementioned documents, or any other technical specifications identified therein, the most stringent requirements shall take precedence.

3.08.01A Facility

The station shall include: Submersible pumps, wet well, valve vault, associated piping and valves, electrical controls, instrumentation, telemetry, access road, fencing, landscaping, and potable water supply.

3.08.01B Capacity

Pump station shall be designed to pump the peak wastewater flow from the service area. When the service area is not built-out, staging of pump station capacity may be allowed.

3.08.01C Standby Power

At a minimum a connection for an external power source must be provided. Where the flow is substantial or where environmental damage may occur due to power failure, the Engineer may require permanent standby power.

3.08.02 Design

3.08.02A Calculations Required

Service area, peak flow, and pump station calculations shall be submitted to the Project Manager.

3.08.02B Storage Volume

Wet well shall be designed to provide 4-hours of wastewater inflow storage above high water alarm elevation.

3.08.03 Materials

3.08.03A Pumps

A minimum of 2 pumps shall be supplied. Each pump shall be capable of pumping the peak wastewater flow. Where more than 2 pumps are used, the station shall be able to pump peak wastewater flow when the largest pump is out of service.

Pumps shall be submersible pumps manufactured by FLYGT (or equal), explosion-proof, suitable for hazardous location, capable of passing solids and shall be UL or FM listed.

3.08.03B Piping and Valves

Piping and valves shall be in accordance with DEQ publication "Oregon Standards for Design and Construction of Wastewater Pump Stations".

3.08.03C Electrical

Electrical controls shall be located above ground mounted in a waterproof enclosure. Electrical panels shall be UL listed. The pump station wet well shall be considered a hazardous location.

3.08.03D Controls

Pump stations shall utilize a PLC-based control system.

An ultrasonic level transducer shall control pump operation and alarms.

A redundant float activated circuit shall provide a fail-safe, high-water alarm system. The Engineer shall provide the brand and model of the programmable logic controller, as well as other devices, in order to ensure compatibility with the existing system.

Control system design shall be subject to the approval of the Engineer.

3.08.03E *Alarms and Telemetry*

Alarms shall be telemetered to the City of Gresham Wastewater Treatment Plant. Telemetry shall conform to specifications and requirements provided by the Engineer to ensure compatibility with existing systems. Required alarms include:

- Pump failure
- Power failure
- High water
- Telemetry failure

3.08.03F *Landscaping and Fencing*

Refer to plans and specifications for the City of Gresham Standard Submersible Pump Station. A copy of these documents may be obtained from the City's Wastewater Division.

3.08.03G *Additional Features*

Provide 1-inch hose bib at valve vault. Potable water shall be provided by reduced pressure backflow preventer.

Provide positive ventilation in valve vault.

Provide odor control systems as required by the City.

3.08.03H *Force Main*

Force main shall be designed for a nominal flow velocity in the range of 3-feet to 5-feet per second.

3.08.04 *Construction*

3.08.04A *Code Authority*

Pump station and related facilities will be constructed in conformance with City of Gresham Electrical and Building Codes.

3.08.04B *Fabricated Steel Surface Finish*

Steel fabrications shall be 304 stainless steel or hot dipped galvanized. Corrosion resistant painting shall be required on valves, piping, and pipe fittings or other items not galvanizable.

3.08.04C *Operating and Maintenance Data*

Prepare an operation and maintenance (O&M) manual including all product data and related information necessary for the City's operation and maintenance of all products and systems provided with the pump station.

The O&M manual shall conform to the guidelines as set forth in the Oregon DEQ publication “Guidelines for Writing Pump Station O&M Manuals”.

3.08.04D *Spare Parts*

Supply two sets each of all gaskets, bearings, and mechanical seals for rotating equipment.

SECTION FOUR – STORM DRAINAGE

4.01 GENERAL DESIGN REQUIREMENTS

Performance Standards – Storm drainage design within a development area must include provisions to adequately control runoff from all public and private streets, and the roof, footing, and area drains of residential, multi-family, commercial, or industrial buildings. The design must ensure future extension of the drainage system to the entire drainage basin in conformance with the adopted Storm Drainage Master Plans and these Design Standards. These provisions include:

Surface or subsurface drainage, caused or affected by the changing of the natural grade of the existing ground or removal of natural ground cover or placement of impervious surfaces, shall not be allowed to flow over adjacent public or private property in a volume or location materially different from that which existed before development occurred, but shall be collected and conveyed in an approved manner to an approved point of disposal.

Surface water entering the subject property shall be received at the naturally occurring locations, and surface water exiting the subject property shall be discharged at the natural locations with adequate energy dissipaters within the subject property to minimize downstream damage and with no diversion at any of these points.

The approved point of disposal for all stormwater may be a storm drain, existing open channel, creek, and detention or retention pond approved by the Engineer. Acceptance of proposed systems will depend upon the prevailing site conditions, capacity of existing downstream facilities, and feasibility of the design.

When adjacent private property must be crossed in order to reach an approved point of disposal, it shall be the developer's responsibility to acquire a recorded drainage easement (of dimensions in accordance with those included in **Subsection 4.11.03**). The drainage facility installed must be a piped system. Temporary drainage ditch facilities, when approved, must be engineered to contain the stormwater without causing erosion or other adverse effects to the adjacent private property.

The peak discharge from the subject property, for all applicable design storms, may not be increased from conditions existing prior to the proposed development.

Retention and/or detention facilities will be required, where necessary, to maintain surface runoff rates from the subject property at or below the existing runoff rates for all applicable design storms.

Drainage from roofs, footings, downspouts, and side yard swales may only drain directly to a street through the curb under the following circumstances:

1. Onsite disposal is not practical, or
2. The building pad ground elevation is at least 2-feet above the existing street curb, and
3. The existing street is adequately crowned to avoid sheet flow across the street. This requirement may be waived if on narrow streets or on a case-by-case basis.

Vegetation shall be established on areas disturbed or on areas of construction, as necessary, to minimize erosion in accordance with the City's Erosion Prevention & Sediment Control manual.

Stormwater quality facilities will be required to control the discharge of pollutants from development to the municipal storm drainage system or natural watercourse.

All storm drain system designs shall make adequate provisions for collecting all stormwater runoff. The system shall accommodate all runoff from upstream tributary areas whether or not such areas are within the proposed development. The amount of runoff to be accommodated shall be based upon ultimate development of all upstream tributary areas.

Proposed storm drain systems shall not discharge flows into inadequate downstream systems.

Public storm lines shall be located within the public right-of-way per **Subsection 4.11.01**, except as noted in **Subsection 3.02.04**. When system access facilities such as manholes, cleanouts, inlets, and outfalls are constructed beyond access from the roadway, a heavy vehicle accessway shall be provided as shown in Standard Detail 605.

4.01.01 Site Drainage Plans

Existing Drainage Plan – Provide a topographical contour map defining existing conditions to include the following minimum information:

- 2-foot contour intervals; slopes over 10% may use 5-foot intervals; extend contours a minimum of 100-feet beyond property
- All structures, buildings, parking lots, and utilities on the property
- Location of all existing drainage facilities and water courses, including wetlands and floodplain areas
- Locations of all subsurface water outlets (e.g., springs)
- Show arrows to indicate direction of flow for all surface drainage information

Proposed Drainage Plan – Show proposed site grading and drainage facilities on a topographical contour map. Unless the detail for proposed improvements will obscure the conditions shown on the existing drainage plan, proposed site grading and drainage may be shown on the existing drainage plan. The following minimum information shall also be shown:

- Finished contours of the property after development at 2-foot or 5-foot intervals as required
- Percent grade for graded slopes and elevations, dimensions, and locations for all graded slopes
- Cut/fill areas; structural fill placement areas; erosion prevention and sedimentation control methods; reseeding areas
- All proposed drainage facilities – public and private systems; paved areas, curbs, and sidewalks; drainage ditches and culverts

Drainage Calculations – Furnish such supporting information as required per **Section 2.04** of these Design Standards. This information shall include basin (sub-catchment) boundary maps, a site Drainage Submittal Summary sheet (as provided by the City), discharge rates, velocities at the system outfall, and hydraulic grade line calculations where required by the City.

Detention Requirements – All proposed development would be required to use adequate drainage management practices. Developments located within a master planned drainage basin will follow the recommendations adopted in that plan. Developments not located within master planned drainage basins will minimize the rate and amount of runoff to receiving systems and streams as required by the City. Onsite storm detention will be required as necessary to ensure that new development does not increase flooding or erosion downstream.

4.02 MINIMUM DESIGN CRITERIA

Storm Frequency – All public storm drain systems shall be designed for the design storm recurrence interval in the following table:

DRAINAGE SYSTEM DESIGN CAPACITY		
Drainage System Element		Design Storm Recurrence Interval (Years)
Minor:	Streets, curbs, gutters, inlets, catch basin and connector drains	10
Major:	Laterals (collectors) <250 tributary acres	10
	Trunk >250 tributary acres	50*
	Arterial Streets and the Drainage System in or under Arterial Streets	50*
Watercourses:	Without designated floodplain	50
	With designated floodplain	100
Bridges:		100
Detention Facilities:	Storage volume (onsite)	25
	Storage volume	100
	Discharge rate	Function of downstream capacity
Retention Facilities:	Drywell infiltration capacity	25**

*Surcharged conditions for pipe systems and culverts and bank-full conditions for open ditches and channels are acceptable only for demonstrating the adequacy of the conveyance system to convey the peak runoff for the 25 or 50-year design storms (as required) provided that:

- runoff is contained within defined conveyance system elements; AND
- the hydraulic grade line does not exceed the elevation of the roadway subgrade; AND
- no portions of a building will be flooded.

**Maximum allowable design capacity = 1200 GPM = 2.67 CFS per drywell.

Conveyance system adequacy shall be demonstrated by performing a backwater analysis.

Time of Concentration – Overland flow of runoff to the initial catchment point into the storm drain system shall be a minimum of 10 minutes.

Velocity and Slope – All storm drains shall be on a grade that produces a mean velocity, when flowing full, of at least 3-feet per second.

Velocity in Natural Channels – Control of discharge from developed areas to natural channels shall be such that the average velocity resulting from all design storms less than or equal to the 10-year event remains below the erosive velocity of the channel.

Manning's Equations – When calculating minimum pipe slopes and velocities, the design engineer shall use the Manning pipe friction formula.

Pipe Coefficient – The storm drainpipe roughness coefficient to be used in the Manning formula shall be not less than 0.013.

Stormwater Flows – Several methods are available to engineers for estimating peak runoff rates. Three of these are the "Rational Method", the SCS "Curve Number" method, and the Santa Barbara Urban Hydrograph

(SBUH) method. These methods will be acceptable for estimating the peak runoff rates to be used in sizing storm drainage conveyance improvements in those areas for which there are no specific master plan recommendations.

Detention Volumes – Several methods are available for the calculation of runoff rate volumes for the purpose of calculating detention/retention storage volume requirements. Detention volume estimates shall be based on hydrographs developed for the storm duration specified by the City for the applicable return frequencies. A method shall be used that routes the design hydrograph through the proposed detention system. Unless specified otherwise, the standard design storm duration shall be 24-hours. For development of the appropriate hyetograph(s), the SCS Type 1A 24-hour rainfall distribution is currently being accepted for all development submittals. If necessary, that distribution may be obtained from the City. A table of 24-hour rainfall depths for storms with 2, 5, 25, and 100-year recurrence intervals is also available from the City. For methods based on the SCS “curve number” approach, the City provides a table of the SCS soil types found within the City along with their respective hydrologic soil groups. A second table is available that associates runoff curve numbers (CN) with the hydrologic soil groups and a variety of land uses. This table is intended as guidance only. The Rational Method, or other “intensity based” methods shall not be used to establish storage volume calculations or allowable release rates for detention facilities.

4.03 FLOODPLAIN INFORMATION

Floodplain information, delineating the floodway and 100-year floodplain limits, shall be shown where it occurs within the development. Floodplain limits shall be based on maps prepared by the U.S. Army Corps of Engineers and the Federal Emergency Management Agency (FEMA). Where better information is available, it shall be used.

4.04 DOWNSTREAM ANALYSIS REPORT

The downstream analysis will show what impacts, if any, a project will have on the hydraulic conveyance system(s) downstream of the project site. The analysis is to be divided sequentially into 3 parts. The 3 parts include: (1) review of resources, (2) inspection of the affected area, and (3) analysis of downstream effects.

(1) During the review of resources, the Engineer of Record must review any existing data concerning drainage of the project area. This data will commonly include area maps, floodplain maps, wetland inventories, stream surveys, habitat surveys, engineering reports concerning the entire drainage basin, inventories of known drainage problems, and previously completed downstream analyses. The City may be able to provide most of this information. Other sources of information include, Oregon Department of Environmental Quality, Oregon Division of State Lands, Department of Fish and Wildlife, and other local agencies.

(2) During the inspection of the affected area, the Engineer of Record must physically inspect the drainage system at the project site and downstream of the site. During the inspection, the Engineer of Record should investigate any problems or areas of concern that were noted during the review of resources. The Engineer of Record should also identify any existing or potential capacity problems in the drainage system, any existing or potential areas where flooding may occur, any existing or potential areas of channel destruction (including erosion and sedimentation), and existing or potential areas of significant destruction of aquatic habitat.

(3) During the analysis of downstream effects, the information that has been gathered must be analyzed to determine if construction of the project will create any drainage problems downstream or will make any existing problems worse. Often, if the other minimum requirements are met, the project will not negatively impact the downstream drainage system. There are however some situations that, although minimum requirements have been met, will still have negative impacts. Whenever a situation is encountered where it has been determined that there will be negative impacts resulting from the project, mitigation measures must be included in the project to correct for the impacts.

4.05 CULVERTS

Culverts at road crossings in natural perennial channels shall be designed to pass the peak discharge for the 25-year design storm such that the headwater water surface elevation:

- a. does not exceed 1.5 times the culvert diameter; OR

- b. remains at least 1 foot below the roadway subgrade, whichever is less

Water crossing structures on all creeks and tributaries shall be constructed and maintained so as to not impede or eliminate a native fish species' access to habitat or ability to migrate. Proposed culvert crossings, regardless of tributary size, intermittent or perennial, shall conform to Oregon Department of Fish & Wildlife and National Marine Fisheries Service's regulations and stream crossing guidelines.

4.06 BRIDGES

New and replacement bridges over natural perennial channels shall be designed to pass the 100-year peak discharge from the tributary area assuming full development. Vertical clearance between the design water surface and the bottom of any part of the bridge shall be a minimum of 2-feet or 25% of the mean channel width between ordinary high water marks at the crossing, whichever is greater.

4.07 EROSION PREVENTION AND SEDIMENT CONTROL

4.07.01 General

Developments shall provide erosion prevention and sediment control methods in accordance with the City of Gresham "Erosion Prevention and Sediment Control Manual" to limit the transportation of soil materials by storm runoff and construction activities during all phases of the construction project.

Obtaining permits from outside agencies are the responsibility of the applicant. These agencies include, but are not limited to, the Department of Environmental Quality, the National Marine Fisheries Service, the Division of State Lands, the Army Corps of Engineers, and the Oregon Department of Fish and Wildlife.

4.07.02 Erosion Prevention Sediment Control Plan

Perform erosion study including review of maps and aerial photos, distinctive minerals, alluvial fans, precipitation patterns, watershed size, topography, soil types, groundcover, and land use.

Select site-specific erosion prevention and sediment control materials based on effectiveness, environmental impacts, regulatory acceptability, long-term cost (maintenance), and public acceptability.

Gather information and requirements from outside agencies as listed above.

Gather field information including topography, existing drainage upstream and downstream, sensitive areas, soil samples, and critical habitat including wetlands vegetation profile.

Use the revised Universal Soil Loss Equation (RUSLE) "A" to determine base-line site erosion:

$$A = R \times K \times LS \times C \times P$$

Where:

A	=	Average annual rate of erosion in tons/acre/year
R	=	Rainfall factor
K	=	Soil erodibility factor (from Natural Resource Conservation Service Ratings)
L	=	Slope length
S	=	Slope gradient
C	=	Cover
P	=	Conservation practice

Develop the construction plan by establishing primary access point(s) for construction traffic, laying out limits of clearing and construction activities, restricting all activities in sensitive areas (mark accordingly), establishing base measures including sediment control at toe of disturbed areas and stabilized construction entrances, and establishing maintenance procedures for EPSC measures. Establish permanent ground cover or landscaping prior to removing base measures as approved by permitting City. The plan shall also include construction notes, BMP's

standard symbols, names of existing roads, waterways and drainage features, boundaries of environmentally sensitive areas such as wetlands, rights-of-way and easements, existing and proposed contour lines, and, if applicable, wind erosion control during/following construction. Additional base measures will be necessary during the wet weather season (October 1st through May 31st).

Recommended erosion control grass seed mixes are as follows. Similar mixes designed to achieve erosion control may be substituted if approved by local jurisdiction. Native plantings should be used whenever possible.

1. Dwarf Grass Mix (low height, low maintenance); Dwarf Perennial Ryegrass, 80% by weight; Creeping Red Fescue, 20% by weight; Application rate = 100-pounds minimum per acre
2. Standard Height Grass Mix; Annual Ryegrass, 40% by weight; Turf-type Fescue, 60% by weight; Application rate = 100-pounds minimum per acre

Hydro-mulch shall be applied with grass seed at a rate of 2,000 pounds/acre. On slopes steeper than 10%, hydro-seed and mulch shall be applied with a bonding agent (tackifier) and application rate and methodology to be in accordance with seed supplier recommendations.

Permanent or temporary irrigation shall be supplied especially in abnormally hot or dry weather or on adverse sites. Water application rates shall be controlled to provide adequate moisture without causing runoff.

Establish requirements for permanent ground cover or landscaping to be installed prior to removal of base measures.

4.08 STORMWATER DETENTION/RETENTION

There are 4 drainage basins within the City, each with unique flood control problems; these are Johnson Creek, Fairview Creek, Kelly Creek and West Gresham. Detention/retention requirements and methods are evaluated on a case-by-case basis and may vary between and within basins.

4.08.04 Development not Requiring Detention

In general, developments meeting the following criteria will not be required to provide detention:

- a. Partitions
- b. Multi-family developments of less than 4 units
- c. Commercial and industrial development where the construction of a new facility or expansion of an existing facility will not increase the impervious area by 5,000 square feet or more

4.08.02 Detention Volume

When detention is required or downstream facilities are inadequate, the volume to be detained will be the volume necessary to limit the developed site peak discharge to pre-developed rates for all storm events with a recurrence interval less than or equal to 25-years.

4.08.03 Emergency Overflow

The Engineer of Record shall assess the impacts of system failure for onsite detention. Overflow may occur due to rainfall intensity that exceeds the design storm, debris blockage of storm drain system, or some other reason.

If a system overflows it shall not cause inundation of neighboring properties. Potential overflow routes shall be protected from erosion and/or structural failure by adequate means.

If surface detention (e.g., detention/retention pond) is used, an overflow system shall be included

to provide controlled discharge of the 100-year, 24-hour design storm event for developed conditions, without overtopping any part of the pond embankment or exceeding the capacity of the emergency spillway. The overflow design shall assume failure of the normal outlet control structure. An emergency spillway shall be able to safely pass all flows over the pond embankment without overtopping the embankment. Sufficient armoring will be required to the toe on each face of the embankment to prevent failure of the embankment from erosion.

4.08.04 Detention Facility Design

There are generally 2 types of detention facilities – surface storage (e.g., ponds) and piped systems (or a combination thereof). While the City prefers surface storage systems, either type may be used.

Detention facilities shall not be considered sedimentation facilities unless the following minimum requirements are met:

- a. The sediment control portion of the facility must be either a separate pond or structure, or a separate “cell” or element that is isolated from the high flows generated by larger storms that could flush accumulated material back into the stormwater system or channel.
- b. Separate calculations shall be submitted demonstrating the designed performance of the sedimentation element. Information must include an explanation of the function of the facility, the required live and dead storage volumes, detention time, and projected frequency of maintenance.

4.08.05 Infiltration Facility Design

When infiltration groundwater recharge disposal of stormwater is proposed, the following shall be submitted for review:

- a. Soil Logs – A minimum of one soil log per acre. Each soil log shall extend to a depth of at least 5-feet below the bottom elevation of the proposed infiltration facility or to the seasonal water table elevation.
- b. Infiltration Tests – The results of infiltration tests which have been performed in accordance with City requirements and procedures in the subsection.
- c. Engineer’s Opinion – The written opinion of a qualified soils engineer that the site is capable of supporting a functional infiltration system that will meet the design requirements for the development being proposed. Any requirements related to steep slope, landslide hazard, or other sensitive area impacts shall also be addressed in the report.

Infiltration facilities shall not be allowed outside of the City’s designated sump area within the City. Maps of this area are available upon request.

In addition to all other applicable requirements, the approval of infiltration groundwater recharge stormwater disposal systems requires the performance of one or more percolation tests. The number and location of these tests will be dependent upon the size and location of the subject property, and shall be submitted to the City for review prior to testing. All test measurements shall be made during the period when groundwater level is expected to be at its maximum. All tests made for the purpose of approval of infiltration systems shall be performed under conditions in which the surrounding soil is saturated, or nearly so. The infiltration rate test procedure shown below simulates this condition. All tests shall be conducted in accordance with this procedure.

Maximum Infiltration Rate Test

This test is used to determine the maximum subsurface infiltration rate for the purpose of designing infiltration systems such as drywells and infiltration trenches, ponds, or vaults. The purpose of the procedure is to ensure the simulation of actual conditions that occur during storms, including the saturation of the surrounding soil.

1. An excavation shall be made to the bottom elevation of the proposed infiltration system. The maximum infiltration rate shall be determined using either the EPA falling head percolation test procedure (Design Manual – Onsite Wastewater Treatment and Disposal Systems, EPA, 1980) or the double ring infiltrometer test (ASTM D3385).
2. The test hole or apparatus is filled with water and maintained at depths above the test elevation for a period of not less than 4-hours. This represents the saturation period.
3. Following the saturation period, the infiltration rate shall be determined in accordance with one of the test procedures specified above with a head of 6-inches of water.
4. The Engineer shall perform at least 2 tests per acre to determine a representative infiltration rate for the site. The measured rate shall have the following factors of safety applied:

EPA Method	Factor of Safety = 2.0
ASTM D-3385	Factor of Safety = 1.75

All newly constructed stormwater drywells (sumps) shall be tested prior to paving in order to determine their in-place capacity. Testing of both new and existing drywells shall follow the procedure outlined below:

- a. Fill sump with water at an initial rate equivalent to the minimum required flow rate for the sump, or 300 GPM, whichever is less, and record the water surface elevation below the sump rim after 5-minutes. Maintain the initial flow rate recording the water surface elevation every 5-minutes until it stabilizes.
- b. After the water surface elevation stabilizes, increase the flow rate by 300 GPM and record the water elevation as in Step 1.
- c. Repeat Step 2 until:
 - (1) the sump has reached the design capacity; or
 - (2) the sump has reached the maximum allowable capacity for a single drywell; or
 - (3) the sump has reached its actual in-place capacity; or
 - (4) the maximum flow rate from the water source has been reached.

(Note: The minimum peak inflow for a test to be considered valid shall be 600 GPM unless this exceeds the design capacity of the sump.)
- d. Cease discharge of water to the sump and record the water surface elevation every minute until the sump is empty or the water surface has remained constant for a period of 5-minutes.
- e. Provide the City with all recorded test data within 24-hours following the test.
- f. If, following analysis of the test data, the tested capacity of the drywell is less than the design capacity, contact the City immediately.

The City must be notified at least 24-hours prior to conducting the test. Only clean water shall be delivered to the sump or sedimentation manhole for testing. The introduction of silts, sediments, gravels, or any other foreign material shall not be permitted.

4.09 STORMWATER QUALITY TREATMENT

General Requirements and Applicability

The purpose of the water quality treatment facilities is to reduce the pollutants associated with stormwater runoff from new development and redevelopment. By establishing these criteria, the City is satisfying federal regulatory requirements to control the discharge of pollutants into stormwater as specified in the Clean Water Act Amendments of 1987 and its National Pollutant Discharge Elimination System (NPDES) permit for discharges from a municipally owned and operated separate storm sewer system issued by the Oregon Department of Environmental Quality (DEQ) under authority of the United States Environmental Protection Agency (EPA).

The requirements are minimum standards. If the City determines that additional controls are necessary in basins that drain to sensitive receiving waters or groundwater sources (such as defined by the DEQ's 303d, and proposed Total Maximum Daily Load (TMDL) requirements for water-quality limited streams, the DEQ's Underground Injection Control Regulations, or Federally designated threatened and endangered fish listings), additional facilities, treatments, or other best management practices (BMP's) may be required. These requirements could include larger facility designs as well as additional types of water quality controls.

It is the responsibility of the City and property owners to meet stormwater treatment requirements. The "Water Quality Manual" offers some methods of achieving water quality control requirements. While there has been significant advances in the field of stormwater treatment technologies, the water quality program still requires a best effort attempt at installing facilities that will address the commonly predictable stormwater problems of a development. Therefore, it is essential that the site planner and the design engineer consider the future use of a site and provide solutions for any predictable water quality problems.

All new development and redevelopment applying for a permit application on or after January 1, 1999, are to meet the stormwater treatment requirements as adopted by the Council Order No. 489. The "Water Quality Manual" provides guidance for selection and basic design considerations of stormwater quality facilities in the City of Gresham.

4.10 PRIVATE STORM DRAIN SYSTEMS

4.10.01 Subdivisions

When subdivision lots drain to the rear, it may be necessary to provide a private storm drain system in private easements. This system shall be for collection of roof drains, footing drains, and surface runoff. This system shall be designed to meet the Uniform Plumbing Code requirements.

4.10.02 Subsurface Drainage

The drainage line installed shall begin at a cleanout and terminate at an approved point of disposal. Open-jointed storm drain lines will not be considered as an acceptable solution.

Subsurface drains (under-drains) shall be provided at the following locations:

- a. For all existing springs and field tile intercepted during construction activity for other facilities; i.e., sewer/water mains, street excavations, foundations, etc., except subsurface drains are not needed if the entire tile system is removed.
- b. Where high groundwater exists or when it is necessary to reduce the piezometric surface to an acceptable level to prevent land slippage or under-floor flooding of buildings.

4.11 ALIGNMENT AND COVER

4.11.01 Right-of-way Location

Storm drain lines shall generally be located five 5-feet south or east from right-of-way centerline. All changes in direction of pipe shall be made at an approved structure.

Storm drain systems shall be located in the street right-of-way. If streets have curved alignments, the center of manhole shall not be less than 6-feet from the curb face.

Curved alignments in stormwater systems, vertically or horizontally, are not permitted.

4.11.02 Minimum Cover

All storm drains shall be laid at a depth sufficient to protect against damage by traffic and to drain building footings where practical. Sufficient depth shall mean the minimum cover from the top of the pipe to finish grade at the storm drain alignment.

Minimum cover shall be 30-inches above the top of the pipe in paved areas and 36-inches at all other locations.

In areas of relatively flat terrain, the design engineer must show that sufficient depth is provided at the boundary of the development to properly drain the remainder of the upstream basin area contributing to the site.

4.11.03 Easements

Easements shall meet the requirements of **Subsection 3.02.04** except as noted below.

Open channels shall have easements sufficient in width to cover the 100-year floodplain line when a 100-year design storm is required, or 15-feet from the waterway centerline, or 10-feet from the top of the recognized bank, or such a distance that is required by the Water Quality Resource Area Overlay District – Article V of the GCDP, whichever is greater. In addition, a 15-foot wide access easement shall be provided on both sides of the channel for channel widths greater than 14-feet at the top of the recognized bank.

4.11.04 Relation to Watercourses

Storm drain lines shall enter a creek or drainage channel at 60° or less to the direction of flow. The outlet shall have a head wall and scour pad or riprap to prevent erosion of the existing bank or channel bottom. The size of pipe or channel being entered will govern which protective measures are required. All protective measures must conform to the requirements of **Subsection 4.12.04**.

4.11.05 Outfalls on Slopes

Outfalls proposed on slopes greater than 15% or greater than 20-feet in height must meet one of the following criteria:

1. The discharge must be less than 0.5 cfs; or
2. A tight-line conveyance system must be constructed to convey the runoff to the bottom of the slope with adequate energy dissipation at the bottom to protect the toe of the slope and/or the receiving watercourse from erosion.

4.12 STRUCTURES

4.12.01 Manholes

Manholes shall be located at all changes in pipe slope, alignment, size, type, and at all pipe junctions with present or future storm drains.

Manhole spacing shall not be greater than 500-feet.

When the downstream pipe size increases, the crown of all upstream pipes shall not be lower than the crown of the larger downstream pipe.

4.12.02 Catch Basins

Catch basins shall be located in streets at the curb line to receive storm water runoff and convey it to the main storm drain.

Catch basins shall be located at the following locations, but in no case be spaced further than 400-feet:

- a. At curb returns on the upstream side of an intersection
- b. At the ends of all dead-end streets with a descending grade
- c. At intermediate locations so that storm flows at the curb line do not exceed 3-feet in width (measured from the curb face) or 3-inches in depth (measured at the curb face), whichever is less
- d. At the downstream end of the street improvements that abut unimproved roads or undeveloped property
- e. At the upstream end of the street improvements that abut unimproved roads or undeveloped property
- f. A single unit double catch basin is required at low point (sag) of all vertical curves. Refer to Standard Detail 402

Catch basins shall be capable of intercepting completely the design storm flow at the curb.

4.12.03 Inlet Manholes

Where stormwater systems connect to the existing or proposed public stormwater system at a catch basin location, inlet manholes shall be required where any of the following apply: (a) the pipe connection is larger than 6-inches in diameter, (b) 2 or more pipes discharge to the location, or (c) the design peak flow from the onsite system exceeds 0.5 cfs. Refer to Standard Detail 406-A, 406-B, or 406-C.

4.12.04 Outfall Protection

The outfalls of all stormwater systems shall be adequately protected to prevent erosion of slopes and channels. All outfalls shall include, at a minimum, the erosion protection as shown in the table below. Alternative approaches to protection may be accepted as approved by the Engineer.

ROCK PROTECTION AT OUTFALLS						
DISCHARGE VELOCITY AT DESIGN FLOW (fps)		REQUIRED PROTECTION				
Greater than	Less than or equal to	Minimum Dimensions				
		Type	Thickness	Width	Length	Height
0	5	Riprap*	1-foot	Diameter + 6-feet		Crown + 1-foot
5	10	Riprap**	1-foot	Diameter + 6-feet or 3 times diameter, whichever is greater		Crown + 1-foot
10	20	Gabion Outfall	1-foot	(As required)	(As required)	Crown + 1-foot
20	----	Engineered energy dissipater required				
Riprap to be reasonably well graded with the following gradation:						
* Maximum stone size		=	8-inches	** Maximum stone size		= 24-inches
Median stone size		=	6-inches	Median stone size		= 16-inches
Minimum stone size		=	2-inches	Minimum stone size		= 4-inches

4.13 PIPE MATERIALS AND SIZE

All public storm drains shall be constructed with either concrete or HDPE smooth interior, corrugated exterior pipe as specified in the Construction Standard Specifications. Where required, for added strength, Class 50 or greater ductile iron pipe will be used. Concrete pipe strength shall meet the applicable sections of ASTM C-76.

Aluminized steel Type II spiral rib pipe may be used for private detention pipe applications only. Structural end-cap bracing specifications from the manufacturer are required. Refer to: Standard Detail 408.

Private storm drainpipe shall meet the appropriate sections of the Uniform Plumbing Code.

All public storm drain main lines and lateral lines to catch basins and other inlet structures shall be a minimum of 12-inches in diameter, except that storm drain lines that convey water directly from private property may be a minimum of 6-inches in diameter if they do not extend into the roadway. All lines must discharge into a drainage structure of the public system and at a location and elevation approved by the City.

SECTION FIVE – WATER SYSTEMS

5.01 GENERAL DESIGN REQUIREMENTS

Performance Standards – Water distribution systems shall be designed to meet Oregon Administrative Rules Chapter 333 (including ORS448), AWWA Standards, and guidelines of the current Water System Master Plan and its updates.

Water system design shall provide adequate flow for fire protection during projected maximum water usage and consumption. Required water system demands shall be met while maintaining the minimum operating pressures of 20psi required by the State of Oregon. For single-family residential areas (including attached single-family) the minimum static pressure shall be 35psi and the minimum fire flow shall be 1,000 GPM. For all other developments, including areas with single-family homes larger than 3,600 square feet or mixed-use areas, the required fire flow shall be as determined by Fire & Emergency Services Department up to a maximum of 3,500 GPM. For requirements above 3,500 GPM, the development shall provide supplemental fire flow as approved by Fire & Emergency Services Department.

Water system design shall meet distribution needs for projected maximum daily demand within a given service area. New water systems shall allow for future extensions beyond present development that are consistent with the master plan. New water systems shall be sized according to the current zoning area fire flow needs, velocity, standards, and water modeling determinations.

All waterlines shall be located within the public right-of-way or as directed and approved by the Engineer. These lines are placed in the public right-of-way for ease of maintenance and access, control of the facility, operation of the facility, and to permit required replacement and/or repair. The Engineer, under special conditions, may allow a public waterline to be located within a public water easement as referenced in **Subsection 5.02.05**.

5.01.01 Pipe, Valve, and Fitting Materials and Size

All public water distribution systems shall be constructed with ductile iron pipe, minimum thickness Class 52. All such pipe shall be cement mortar-lined pipe with push-on or mechanical type joints. When a corrosive potential condition is encountered, all ductile iron pipe and fittings will be polyethylene encased with an 8-mil tubing meeting manufacturer and AWWA Standards. Where an active cathodic protection system is encountered as a result of other utilities, a deviation from the normal pipe design/material/installation practice may be required by the Engineer. PVC pipe may be considered as an alternate to ductile iron pipe where an active cathodic protection system is encountered.

Polyvinyl Chloride (PVC) Pipe and Tracer Wire Installation – PVC pipe 4-inches to 12-inches shall conform to AWWA C-900 and UNI-BELL Standards. All PVC pipe shall have a dimension ratio no greater than 18, with an outside diameter identical to cast iron. Tracer wire shall be a minimum 12-gauge, blue-coated copper wire and shall be installed with all PVC water pipe.

All gate valves shall be pressure rated for 200psi and all butterfly valves shall be pressure rated for 150psi. All ductile iron mechanical joint fittings shall be pressure rated at 350psi. All flanged fittings and cast iron mechanical joint fittings shall be pressure rated at 250psi. All fittings shall be factory cement mortar lined and coated. Pipe constructed per **Subsection 5.02.06** will require the use of restrained pipe joints or ball and socket river pipe.

Water distribution main sizes shall generally conform to the following:

4-inch – May only be used with approval of the Engineer in residential zones on dead-end streets less than a centerline distance of 250-feet measured from the center of the intersection street to the radius point of the cul-de-sac and that serves 12 or fewer single-family residences. All 4-inch mains shall be connected to a looped minimum 6-inch main. Fire hydrants are not permitted on 4-inch lines. All 4-inch lines shall terminate with a standard blow-off (Standard Detail 507A).

6-inch – Minimum size residential subdivision distribution water main for the grid (looped) system. A 6-inch line shall not exceed an unsupported length of 600-feet and shall not be permanently dead-ended. Looping of the distribution grid shall be at least every 600-feet.

8-inch – Minimum size for permanently dead-ended mains supplying fire hydrants with a fire flow of 1,000 GPM and for primary feeder mains in residential subdivisions. Not to exceed an unsupported length of 600-feet unless otherwise approved by the Engineer.

10-inch and larger – As required for primary transmission lines in subdivisions, industrial areas, and commercial areas.

Where system static pressures allow and field flow measurement or system modeling shows adequacy, velocities in distribution mains may be designed but shall not exceed 8-feet per second for combined fire, domestic, and irrigation flows. Velocity in service lines (as defined in **Section 5.05**) shall be designed not to exceed 10-feet per second.

For portions of the water system with mid-range to low-static pressures, required flows may not be achievable while still maintaining a minimum system residual of 20psi. Oversizing of waterlines may be required to achieve the required flows.

5.01.02 Grid System

The distribution system mains shall be looped at all possible locations. All developments will be required to extend mains across existing or proposed streets for future extensions of other developments. All terminations shall be planned and located such that new or existing pavement will not have to be cut in the future when the main is extended.

5.01.03 Dead-end Mains

Dead-end mains that are permanent or that will be extended in the future shall be provided with a properly sized blow-off. See Standard Details 507A and 507B.

The installation of permanent or long-term, dead-end mains greater than 250-feet, upon which fire protection depends, and single mains serving relatively large areas will not be permitted unless otherwise approved by the Engineer.

No more than 20 single-family residences shall be temporarily served from an un-looped waterline during a phased construction, unless approved by the Engineer.

5.02 ALIGNMENT AND COVER

5.02.01 Right-of-way Location

Where waterlines are located within narrow rights-of-way (less than 50-feet), location of waterline shall be reviewed and approved by the Engineer on a case-by-case basis.

In general, water systems shall be located 12-feet south or east from the right-of-way centerline or as approved by the Engineer. Except as provided in **Subsection 5.02.05**, all waterlines shall be in the public right-of-way. All abrupt changes in vertical or horizontal alignment shall be made with a fitting and adequate thrust restraint. Refer to Standard Details 508, 509, and 510.

Curved alignment for waterlines or mains is permitted and shall follow the street centerline when practical. The minimum allowed radius shall be based on allowable pipe deflection for the pipe diameter and the pipe laying length, but not to exceed 3° joint deflections.

5.02.02 Minimum Cover

The standard minimum cover over buried water mains within the street right-of-way shall be 36-inches from finish grade. Standard trench section Standard Detail 502 will be utilized for all water pipe installed.

The minimum cover for mains in unpaved areas shall be 48-inches from finish grade.

Finish grade shall normally mean the existing or proposed pavement elevation. Where the main is located in the cut or fill side slope or where mains are located in easements, finish grade shall mean final ground elevation at the water main alignment.

Deviation from the above standards will be considered on a case-by-case basis when the following exists:

- a. When there is underlying rock strata that prohibits placement of the water main 36-inches below finish grade, a written request must be submitted to the Engineer, together with submission of a soils report with a plan and profile certifying that bedrock exists less than 3-feet below the undisturbed ground surface.
- b. Substantial utilities exist at an elevation conflicting with the waterline at 36-inches below finished grade; and installation of the waterline below such utility would cause the new waterline to be at an unreasonably deep elevation below finished grade.
- c. Where the water main or service is installed at a depth of 24-inches or less below finished grade, controlled density fill (CDF) shall be used in place of standard backfill material.

5.02.03 *Separation with Sewer Lines*

Water mains and services shall be installed a minimum clear distance of 5-feet horizontally from gravity sanitary sewer mains and laterals, and shall be installed to go over the top of such sewers with a minimum of 18-inches of clearance at intersections of these pipes. Separation from sanitary sewer force mains shall be reviewed on a case-by-case basis. Exceptions shall first be approved by the Engineer. In all instances, the distances shall be measured edge to edge.

5.02.04 *Separation with Utilities*

The minimum spacing between water mains and storm drains, gas lines, and other underground utilities, excepting sanitary sewers, shall be 3-feet horizontally when the standard utility location cannot be maintained. This separation also applies to water service and utility service lines.

Where water mains are being designed for installation parallel with other water mains, utility pipe, or conduit lines, the vertical separation shall be 12-inches below or in such a manner that will permit future side connections of mains, hydrants, or services, and avoid conflicts with parallel utilities without abrupt changes in vertical grade of the above mentioned main, hydrant, or service. Where crossing of utilities are required, the minimum vertical clearance shall be 6-inches.

5.02.05 *Easements*

Easements shall meet the requirements of **Subsection 3.02.04** except as noted below.

Any water main placed within a water main easement will be permanently marked with blue plastic markers at all angle points, and no less than every 200-feet, or at a change in direction. In addition, markers shall be placed where the waterline intersects the public right-of-way at the easement location. A monument cap set in the pavement of parking lots, driveways, etc. shall be an acceptable alternative to the sign.

5.02.06 *Relation to Watercourses*

New water mains may cross over or under existing streams, ponds, rivers, or other bodies of water.

Mains crossing stream or drainage channels shall be designed to cross as nearly perpendicular to the channel as possible.

Valves shall be provided at both ends of the water crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding.

a. **Above Water Crossings** – The pipe shall be designed by the Engineer of Record to provide support, anchorage, and protection from freezing and damage, yet shall remain accessible for repair and maintenance. All above water crossings will require review and approval by the Engineer.

b. **Underwater Crossings**

(1) The following surface water crossings will be treated on a case-by-case basis:

(a) Stream or drainage channel crossing for pipes 12-inches inside diameter and greater

(b) River or creek crossings requiring special approval from the Division of State Lands

(2) The minimum cover from the bottom of the streambed or drainage channel to the top of pipe shall be 36-inches, except as noted below.

(3) A scour pad centered on the waterline will be required for mains less than 12-inches inside diameter when the cover from the top of the pipe to the bottom of the streambed or drainage channel is 36-inches or less. The scour pad shall be concrete, 6-inches thick and 6-feet wide; reinforced with #4 bars 12-inches on center both ways; and shall extend to a point where a one-to-one slope begins at the top of the bank and slopes down from the bank away from channel centerline and intersects the top of the pipe. There shall be a minimum 6-inches clearance between bottom of pad and top of waterline.

5.03 APPURTENANCES

5.03.01 Valves

In general, valves shall be the same size as the pipes in which they are installed. Valve types and materials shall conform to the City of Gresham Construction Standard Specifications.

Distribution system valves shall be located at and flanged to the tee or cross fitting. There shall be a sufficient number of valves located so that not more than 4, and preferably 3 valves, must be operated to affect any one particular shutdown. The spacing of valves shall be such that the length of any one shutdown in commercial or industrial areas shall not exceed 500-feet or 800-feet in other areas.

In general, a tee-intersection shall be valved in 2 branches and a cross-intersection shall be valved in 3 branches. Transmission water mains shall have valves at not more than 1,000-foot spacing. Hazardous crossings such as creeks, railroad, and freeway crossings shall be valved on each side. Valves shall be accessible at all times.

When a hydrant tee or a tee branching to a cul-de-sac blow-off is installed in a sloped waterline, install a main line valve on the up hill run of the tee to allow for release of air from hydrant or blow-off. An additional main line valve may be needed on the down hill run of the tee for other operational purposes.

Distribution tees and crosses with valves for future branch lines on transmission mains may be required at the direction of the Engineer.

5.03.02 *Fire Hydrants*

The public water system supplying public fire hydrants shall be designed to provide up to a maximum of 3,500 GPM. Minimum fire flow in single-family residential areas shall be 1,000 GPM, except in areas where homes exceed 3,600 square feet or areas of mixed use, in which case fire flows will be as determined by Fire & Emergency Services Department.

The distribution of hydrants shall be based upon the required average fire flow for the area served. Design coverage shall result in hydrant spacing of approximately 400-feet in residential areas and approximately 300-feet in commercial or industrial subdivisions. Additional hydrants shall be placed as required by Fire & Emergency Services Department and the Engineer.

Residential hydrants shall be located as nearly as possible to the corner of street intersections and not more than 600-feet from any cul-de-sac radius point.

No fire hydrant shall be installed on a main of less than 8-inches inside diameter unless it is in a looped system of 6-inch mains. The hydrant lead shall be a minimum of 6-inches nominal diameter.

All fire hydrants will be located at the back of the existing or proposed sidewalk, in the planter strip, or behind the sidewalk if adequate right-of-way exists. If any public hydrant encroaches on private property, an easement must be provided to the City. In general, fire hydrants will be located at or near the point of curvature of the curb return or at a common property line. Pumper port of fire hydrant shall be perpendicular to the curb line or shoulder as applicable.

No hydrant shall be installed within 5-feet of any existing above-ground utility, nor shall any utility install facilities closer than 5-feet to an existing hydrant.

Hydrant installation shall conform to Standard Detail 501. Maximum 6-foot bury hydrants will be required in all installations. Installation of hydrant extensions will not be allowed, unless approved by the Engineer.

Unless off of a fire line/fire sprinkler service, fire hydrants shall be placed on the same side of the right-of-way as the waterline serving the fire hydrant. Other proposed locations must be approved by the Engineer.

Each fire hydrant shall have an auxiliary valve and valve box that will permit repair of the hydrant without shutting down the main supplying the hydrant. Such auxiliary valves shall be resilient-wedge gate valves. The auxiliary valve shall have mechanical joint-by-flange joint ends as referenced in the Standard Detail 501. The valve shall be connected directly to the water main using a flange joint tee and "Megalug" retainer glands, or approved equal.

Hydrants shall not be located within 20-feet of any building, nor shall they be blocked by parking.

Guard posts, a minimum of 3-feet high, shall be required for protection from vehicles when necessary. Such protection shall consist of 4-inch diameter steel pipes 6-feet long, filled with concrete, buried a minimum of 3-feet deep in concrete and located at the corners of a 6-foot square with the hydrant located in the center. Use of posts other than at the 4 corners may be approved by the Engineer.

5.03.03 *Pressure-reducing and Combination Air Valve Units*

The City's water distribution system is divided into several pressure zones. Where water systems cross these zone lines, a pressure-reducing valve station may be required. The specific design and location for such valves will be reviewed and approved by the Engineer.

When shown on the plans or designated by the Engineer, combination air valve units, per Standard Detail 406, shall be installed. Such valves will be required on large diameter transmission lines at all high points in grade and at other points as determined by the Engineer.

5.03.04 Railroad or Freeway Crossings

All such crossings defined above, or as determined by the City, to be of a hazardous nature shall be valved on both sides of the crossing. Casing of railroad or freeway crossings, if required, shall be as noted in the permit from the respective agency.

5.04 BACKFLOW PREVENTION

Backflow prevention assemblies shall be required on all 1½-inch and larger water services, irrigation services, and fire sprinkler system services, and as provided for in Chapter Five of the Gresham Revised Code. Backflow assemblies shall be located on the lot it serves at the right-of-way line. For installation requirements on assemblies 3-inches through 10-inches, see Standard Detail 516A-D. All assemblies shall be State of Oregon approved and testable.

5.05 WATER SERVICE LINES

The sizes of water service lines that may be used are 1-inch, 2-inch, 4-inch, 6-inch, 8-inch, 10-inch, and 12-inch. Water service lines will be reviewed for impacts on the distribution system and shall not be greater in size than the distribution main. In no case shall a new service be provided off of an existing galvanized waterline.

Domestic service lines 1-inch and 2-inches shall normally extend from the main to behind the curb, with a meter curb stop and meter box located at the termination of the service connection (Standard Details 503, 504A, and 504B). Meter shall be provided and installed by City. Meter boxes are to be provided by the owner. Whenever possible, individual service connections shall terminate in front of the property to be served along the street frontage where property is addressed, and shall be located 36-inches each side of a common side property line. Water service via an easement across a separate parcel under separate ownership, or capable of being sold off, is not allowed unless otherwise approved by the Engineer.

For services 4-inch and larger (3-inch and larger meters), a design drawing must be submitted to the City showing the vault and fitting requirements with the expected flow (normal and maximum daily flow) requirements and proposed usage, and meter vaults shall be placed at the entrance to the property being served, unless otherwise approved by the Engineer. See Standard Detail 515A-D.

Multiple service connections to a premise shall be laid out to follow a logical sequence of addresses to facilitate matching of service connection to building(s). Onsite waterlines shall be laid out to facilitate a logical matching of service connection to building and address. Each meter must have its own service line and connection to a water main. No manifolding will be allowed unless approved by the Engineer.

When a corrosive potential condition is encountered and the copper service passes over or under an active cathodic protection system, the service will be installed in a Schedule 40 PVC conduit for a distance of 10-feet on each side of the active system. All conduit placements shall be included in the as-built drawings.

GENERAL DESIGN CRITERIA		
WATER SERVICE AND METER SIZING		
SERVICE SIZE (INCHES)	METER SIZE (INCHES)	MAXIMUM DESIGN FLOW (GPM)
1	¾	30
1	1	50
2	1½	100
2	2	160
4	3	320
4	4	500
6	6	1,000
8	8	1,600

Notes:	1.	Continuous flow not to exceed 30% of maximum design flow for ¾-inch to 2-inch disk meters
	2.	Continuous flow not to exceed 50% of maximum design flow for all compound meters
	3.	Meters larger than 8-inches will be reviewed on a case-by-case basis

Fire Service – There are 3 categories of private fire services: (1) hydrants, (2) fire sprinkler lines, and (3) combination hydrant and fire sprinkler lines.

The water fire service line shall normally extend from the main to the property line and end with a vault, metering device, and valves. An approved backflow prevention assembly will be required of the property being served.

The City shall install a flow meter and sensor (Data Industrial Series 1400 w/220 MB sensor or approved equal) on all fire lines with onsite fire hydrants. All costs for the installation shall be the responsibility of the property owner being served.

Fire lines serving only fire sprinkler systems shall be metered by a detector meter on the approved backflow assembly.

Whenever possible, the fire service shall be located along the street frontage where the parcel is street addressed.

Fire sprinkler systems for single-family residences or rowhouse-type residences shall be served through a standard metered service. The fire sprinkler system may be served through the domestic service for the same residence. The combined domestic, irrigation, and fire sprinkler flow demands may not exceed the City of Gresham allowable flow for that particular size of service and meter.

Fire Vaults – A vault for a 30-inch and larger double check detector assembly will be required when a development provides fire sprinklers. The vault drawing will be included on construction drawings submitted to the City.

GENERAL DESIGN CRITERIA		
FIRELINE/FIRE SPRINKLER SYSTEM SERVICES		
SERVICE SIZE (INCHES)	METER SIZE (INCHES)	MAXIMUM DESIGN FLOW (GPM)
1	¾	30
1	1	50
2	1½	100
2	2	160
4	City installed flow meter	500
6	City installed flow meter	1,000
8	City installed flow meter	1,600
10	City installed flow meter	2,500
Notes:	1.	Continuous flow not to exceed 30% of maximum design flow for ¾-inch to 2-inch disk meters
	2.	Continuous flow not to exceed 50% of maximum design flow for all compound meters
	3.	Meters larger than 8-inches will be reviewed on a case-by-case basis

5.06 *SYSTEM TESTING*

All new water systems (lines, valves, hydrants, and services) shall be individually pressure tested, chlorinated, and tested for bacteria. All testing shall be performed in accordance with the Gresham Public Works Standards and in the presence of a City Inspector.

No connection to the existing system shall be made until the new system has been tested and accepted.

5.07 *WATER QUALITY SAMPLING STATIONS*

Water sampling stations will be required and installed in all new subdivisions, or as directed by the Engineer. In general, install one station for every 20 lots. See Standard Detail 505.

SECTION SIX – TRANSPORTATION

6.01 GENERAL DESIGN REQUIREMENTS

6.01.01 Performance Standards

All street designs shall provide for the safe and efficient travel of motorist, bicyclists, and pedestrians. Streets shall be designed to carry the recommended traffic volumes identified for each street classification. Street classifications are set forth in the Transportation System Description and Function section of the Gresham Community Development Plan (GCDP).

Streets shall be designed to meet or exceed minimum guidelines. These guidelines are set forth in the “AASHTO Policy on Geometric Design of Highways and Streets” (latest edition). Traffic Control Devices shall conform to the “Manual on Uniform Traffic Control Devices for Streets and Highways” – Federal Highway Administration with Oregon Supplements – Oregon Department of Transportation (latest edition).

All vertical and horizontal curves shall meet the guidelines of the AASHTO policy and the design speed for each street classification. Where practical, the Engineer of Record shall provide the decision sight distance for the design speed based on the methodology in AASHTO Chapter IX, or the stopping sight distance based on the 85% speed as set forth in the AASHTO policy, whichever is greater. Only with the approval of the Engineer shall a lesser sight distance be permitted.

6.01.02 Access

All development shall be provided with public street access. Access streets (public and/or private), driveways, and easements shall be as set forth in other sections of these Design Standards.

6.01.03 Permanent Dead-end Streets

A standard cul-de-sac turnaround shall be provided at the end of a permanent dead-end street that does not provide looped circulation. Permanent dead-end streets shall be limited to service no more than 25 dwellings and shall not exceed 200-feet in length

A permanent dead-end street is measured from the right-of-way line at the furthest end of the dead-end street.

6.01.04 Transportation Analysis

The Engineer will require a traffic analysis report as determined by the type of development and its potential impact to existing street systems. A traffic analysis will generally be required for a development when (1) it will generate 1,000 vehicle trips or more per weekday; or (2) when a development's location, proposed site plan, or traffic characteristics could affect traffic safety, access management, street capacity, or known traffic problems or deficiencies in a development's study area; or (3) when a proposed change in zoning designation could result in higher trip generation than current zoning.

The report will be prepared by a traffic engineer licensed in the State of Oregon. At a minimum the report shall contain the following:

1. Purpose of Report and Study Objectives

A discussion of key traffic issues to be addressed and the transportation system and development objectives related to a specific development.

General transportation system objectives are to:

- maintain easy and safe traffic flow on surrounding street system;

- provide effective and safe transfer of vehicle traffic between the site and the street system;
- provide convenient, safe, and efficient onsite and offsite movement of vehicles, pedestrians, transit, service and delivery vehicles, and bicycles;
- effectively mitigate adverse site-generated traffic impacts on affected streets and intersections – site-specific objectives may be established by the City for each study; and
- analyze accident history in study area and evaluate impacts of site-generated traffic.

2. **Executive Summary**

A concise summary of the study purpose/objectives, site location and study area, development description, key assumptions, findings, conclusions, and recommendations.

3. **Description of Site and Study Area Streets**

A description of the site and study area, existing traffic conditions and accident history in the study area, and anticipated nearby development and committed street improvements that would affect future traffic in the study area.

The study area will be defined by:

All streets, ramps, and intersections through which peak hour site traffic composes at least 5% of the existing capacity of an intersection approach, or street sections or intersections impacted by site traffic on which existing volume to capacity (V/C) ratio exceeds 0.90 or level of service “D”, or accident character or residential traffic character is expected to be significantly impacted.

4. **Onsite Traffic Evaluation**

An evaluation of the proposed (and alternative) site access locations; the adequacy of access drive depth, driveway lanes, and queuing storage; and the safety and efficiency of proposed vehicular circulation, parking layout, and pedestrian and service vehicle routes/facilities, together with recommendations for onsite traffic markings and controls.

5. **Offsite Traffic Analysis**

The analysis shall include:

- Existing daily, p.m. peak hour, and site peak hour counts by traffic movements at intersections affected by generated traffic from the development (use traffic flow diagrams).
- Background daily, p.m. peak hour, and site peak hour volumes for these same intersections and proposed access points. Background traffic includes existing volumes plus traffic projected from in-process development.
- Total daily, p.m. peak hour, and site peak hour volumes for these same intersections and proposed access points when the development is in full service (use traffic flow diagrams). In the case of zoning changes, the traffic study shall assume land uses that result in greatest trip generation. The study shall also include a 20-year forecast.
- A determination of the existing levels of service, background levels of service, and total traffic levels of service at each intersection and access points studied. For signalized intersections, levels of service shall be reported using existing timing plans and lane configurations.

e. A discussion of the need for traffic signals. This should include a traffic warrant computation based on the National Manual on Uniform Traffic Control Devices (latest edition).

f. The recommendations made in the report should be specific and should be based on a minimum level of service “D” with maximum V/C ratio of 0.90 when the development is in full service. Individual movement level of service must meet level of service “E” and a V/C ratio of 1.0. As an example, if a traffic signal is recommended, the recommendation should include the type of traffic signal control and what movements should be signalized. If a storage lane for right turns or left turns is needed, the recommendation should include the amount of storage needed. If several intersections are involved for signalization and an interconnect system is considered, specific analysis should be made concerning progression of traffic between intersections. For stop-controlled intersections, a minimum level of service “E” shall be required on the minor approach. Level of service shall be based on the current edition of the TRB Highway Capacity Manual and the associated Highway Capacity Software. The Engineer may approve other methods.

g. The report should include a discussion of bike and pedestrian usage and the availability of mass transit to serve the development.

6. Recommendations for Public Improvements

Recommendations should be made for external roadway improvements, such as additional through lanes and turn lanes, and traffic control devices necessitated as a result of the development. Recommended improvements to transit facilities and pedestrian and bike circulation should also be reported.

The recommendations should specify the time period within which improvements should be made, particularly if improvements are associated with a phased development, the estimated cost of improvements, and any monitoring of operating conditions and improvements that may be needed. If needed street improvements unrelated to the development are identified during the analysis, such improvements should be reported.

Traffic signals proposed within ¼-mile of nearest signal shall incorporate a Synchro/Simtraffic analysis to verify compatibility of operation. Where time-of-day plans are in operation, proposed signals shall be analyzed with those time-of-day plans and recommendations made accordingly.

7. Access Management

On sites with arterial and collector street frontages, the report shall evaluate and recommend the use of access management plans or techniques to:

- separate basic conflict areas (reduce number of driveways or increase spacing between driveways and intersections); and
- remove turning vehicles or queues from the through lanes (reduce both the frequency and severity of conflicts by providing separate paths and storage area for turning vehicles and queues).

These techniques may include turn restrictions, striping, medians, frontage streets, channelization of lanes or driveways, shared driveways and access between similar uses, access consolidation, lanes for left or right turns, and other transportation system management (TSM) actions.

8. Safe Route to Schools

Traffic studies associated with schools shall include a “Safe Route to School Study”. The purpose of the study is to designate routes that are safe for children to walk to and from school. The route should guide students over the safest and best path to and from school. The route should cross the fewest major streets possible and have the most protection available from existing traffic controls. If necessary, school boundaries should be revised to eliminate extremely hazardous conditions, otherwise bus transportation should be considered. At times,

children may be required to take a longer route to avoid hazardous locations, or to use existing safety features or controls.

9. Technical Appendix

A technical appendix including worksheets, charts, and drawings to support findings described in the body of the report. Include computer diskette with all HCS Synchro/Simtraffic input and output files matching those provided in the traffic analysis report. The files shall be clearly identified on the disc for easy reference.

6.02 STREETS

6.02.01 Street Classification

All streets within the City shall be classified as listed in Section A5.500 – Transportation System Description and Function, Vol. III, GCDP. The classification for any street not listed shall be that determined by the Manager.

6.02.02 Right-of-way and Pavement Width

Right-of-way dedication at intersections shall be along the “long cord”.

Right-of-way and pavement widths for each street classification shall be as follows:

	Right-of-way (Feet)	Curb to Curb Width (Feet)
Principal Arterial	120	84
Arterial	100	76
Boulevard	115	84
Collector	80	60
Community	70	48
Local Transitional	50 ^{a, b}	32 ^{a, b}
Local Queuing	46	26
Local Lane	27	20
Cul-de-sac Turnaround	45 radius	35 radius
Minor Access Street	25	20
Alley – Residential District	15	14
Alley – Commercial/Industrial District	21	20
Notes:		
a.	In the Hillside Constraint District, right-of-way width may be 40-feet and pavement width may be 28-feet with approval of the Manager.	
b.	In Commercial/Industrial, the right-of-way shall be 58-feet and the pavement width shall be 40-feet.	

Local Transitional Street: The local transitional street standard of 32-foot wide pavement applies in the following areas. In all other cases the local queuing standards apply.

1. Continuation of existing local streets in established neighborhoods to the next intersection.
2. In mixed-use neighborhoods.
3. On primary emergency response routes.
4. On local streets where volumes are expected to exceed 800 average daily trips (ADT).

For streets designated collector and below, the design engineer must consider design modifications to conserve major trees in the public right-of-way and submit to the Project Manager for review. Pavement width on a collector street may be reduced to no less than 34-feet, consisting of two 11-foot travel lanes and two 6-foot bicycle lanes.

6.02.03 Half-street and Frontage Improvement Construction

Where half-street is justified, the right-of-way and pavement width will be approved by the Engineer. The pavement width shall be at least ½ of the standard street classification width, but in no case shall the pavement width be less than that required to provide 2 lanes of traffic to pass at a safe distance. For a 32-foot local street, the half-street pavement width will be 20-feet. Half-streets will only be approved when the abutting or opposite frontage property is undeveloped and the full improvement will be provided with development of the abutting or opposite (upon right-of-way dedication) frontage property. Half-streets shall be signed “No Parking” on the improved (curb) side of the street and, if necessary, the unimproved side of the street to provide a clear-traveled way of 20-feet.

A development on an unimproved substandard street shall be responsible for constructing a continuous 20-foot half street to a connection with the nearest standard (publicly-maintained) street.

Frontage improvements will be required in cases where a paved street that is substandard exists along the frontage to be developed. If a pavement design, including an analysis of the existing pavement section, indicates that the existing pavement is adequate to provide a minimum of 20-years design life, then that pavement may remain and only the additional improvements, such as curb and pavement widening, are required. If the analysis indicates that the existing pavement is inadequate, half-street construction as described above will be required.

6.02.04 Pavement Design

In general, all streets shall be constructed with asphaltic concrete (AC); however, other materials such as portland cement concrete (PCC), concrete paver stones, etc., are permitted as approved by the Engineer. When required by the City, all public street improvements shall include a specific pavement design based on existing soil conditions and the recommended traffic volumes for the street classification.

- **Street Pavements** – The street pavement sections shown in the Standard Detail are typical and are comprised of PCC or AC with crushed rock base on compacted subgrade soil. Treated subgrades in the pavement section are also acceptable as approved by the Engineer.
- **Soil Tests** – Conduct 2 soil tests for projects that have 500-feet or less of new street. An additional soil test may be required for each additional 500-foot section. For asphalt pavements, conduct soil testing to determine the design subgrade resilient modulus (Mr) within the top 2-feet of the proposed subgrade elevation.
- **Design Life** – 20-years.
- **Design Procedure/Asphalt Pavements** – The design procedures contained in the following references are preferred (see the References section for full citations).
AASHTO Guide for Design of Pavement Structures, current edition – American Association of State Highway and Transportation Officials.
Thickness Design – Asphalt Pavements for Highways and Streets, current edition – The Asphalt Institute.
- **Design Procedure/Concrete Pavements** – The design procedures contained in the following references are preferred (see the References section for full citations).
AASHTO Guide for Design of Pavement Structures, current edition.
Thickness Design for Concrete Highway and Street Pavements, current edition – Portland Cement Association.
- **Minimum Thickness** – The thickness designs specified in the Standard Details are minimums. Actual pavement thickness may be based on specific pavement designs as approved by the Engineer.
- **Local Street and Community Street Asphalt Pavement** – Specify ½-inch Level 2 surface course with a minimum thickness of 2-inches. Specify the base course of asphalt concrete as ½-inch Level 2 with a minimum thickness of 2-inches.

- **Arterial, Boulevard, and Collector Asphalt Pavement** – Specify ½-inch Level 2 wearing surface with a minimum thickness of 2-inches. Specify the base course of asphalt concrete as ½-inch or ¾-inch Level 2 with the thickness as identified on the Standard Details.
- **Treated Base Materials** – For asphalt pavement sections that include either a cement treated base (CTB) or an asphalt treated base (ATB), specify a finish surface pavement of not less than 3-inches of asphalt concrete.
- Pavement design shall take into account the topography and include subsurface drains and/or geotextiles as required.

6.02.05 *Design Speed*

Design speeds for classified streets shall be as follows:

Principal Arterial	45 – 55 mph*
Arterial	35 – 45 mph*
Boulevard	25 – 35 mph*
Collector	25 – 35 mph
Community Street	25 – 35 mph
Local Transitional/Queuing/ Lane	25 mph
Minor Access Street	15 mph
* Use posted speed where posted speed is within range indicated. Where posted speed is outside range given above, use the closest design speed for that classification.	

6.02.06 *Horizontal Curves*

Horizontal curve radius (on centerline) for each street classification shall be designed according to the roadway design speed. The radius shall not be less than the following:

Design Speed (MPH)	Radius (Feet)
15	100
25	180
30	300
35	450
40	670
45	900

“Loop” roads and other traffic-calmed local roads that are designed to “self enforce”, lower speeds may use centerline radius as low as 50-feet with the Manager’s approval. Such roads shall be limited to low density, residential developments with a maximum number of 50 dwelling units and 500 ADT. Maximum distance between speed control points shall be 500-feet. Speed control points include horizontal curves of 50-feet to 100-feet, traffic circles, textured pavement sections, or other similar traffic calming devices. Use of speed bumps is discouraged.

6.02.07 *Vertical Curves*

Vertical curve length shall be based on the design criteria that include: (1) design speed, (2) crest vertical curve, and (3) sag vertical curve. Stopping sight distance for crest and sag vertical curves shall be based on sight distance and headlight sight distance, respectively.

All vertical curves shall be parabolic and the length shall be computed for each location per AASHTO design criteria.

6.02.08 Grades

Maximum grades for each street classification shall be as follows:

Principal Arterial/Arterial/Boulevard	0.060 ft./ft.	(6%)
Collector	0.080 ft./ft.	(8%)
Community	0.100 ft./ft.	(10%)
Local Transitional	0.120 ft./ft.	(12%)
Local Queuing	0.120 ft./ft.	(12%)
Local Lane	0.120 ft./ft.	(12%)
Minor Access	0.120 ft./ft.	(12%)

Local asphalt concrete streets may exceed 12%, but in no case permitted to exceed 15%. The Engineer may approve a grade greater than 12% when all of the following conditions exist:

1. Topographic constraints do not allow the development to be served by a street with a maximum grade of 12% without causing destabilization of soils by excessive cuts and fills.
2. There is no access to the property being developed through adjacent properties at a maximum 12% grade.
3. The section of local street being designed will not exceed a combination of length, horizontal alignment, or grades exceeding 12% that will create hazardous traffic conditions.

For unsignalized intersections, keep the longitudinal grade on stop-controlled approaches below 8% for an approach distance of 50-feet.

Minimum grade for all streets shall be 0.0050 foot per foot (0.50%). In all cases street grades shall allow for proper and adequate drainage. Cul-de-sac “bulbs” shall have a minimum slope of 0.0060-foot per foot (0.60%).

6.02.09 Concrete Curb

All street improvements will be constructed with monolithic curb and gutter. Standard curb as shown in the Standard Details may only be used when the longitudinal street grade is 0.01 foot per foot (1.0%) or greater; or where cross slope of roadway drains away from curb such as with raised median construction.

6.02.10 Intersections

Connecting street intersections shall be located to provide for traffic flow, safety, and turning movements as conditions warrant. Where signalized, design shall provide for optimal signal phasing. Consideration for arterial street progression, protected/permitted and permitted left turn phasing, shall occur. New signal proposals in remote locations shall first include an evaluation of alternate applications such as roundabouts.

Arterial and Collector Intersections: Exclusive left turn lanes will be provided; crosswalks will be provided at all approaches; street alignments across intersections shall be continuous.

Community and Local Street Intersections: Street and intersection alignments should facilitate local circulation but avoid alignments that encourage non-local through traffic.

Streets shall be aligned so as to intersect at right angles (90°). Angles of less than 70° will not be permitted. Intersection of more than 2 streets at one point will not be permitted.

New streets shall intersect with existing street intersections so that centerlines are not offset, except as provided below. Where existing streets adjacent to a proposed development do not align properly, conditions may be required of the development to provide for proper alignment.

For intersections that are not directly aligned with street centerlines, the centerline spacing must meet the following minimum separation distance:

Street Class	Intersection Spacing (Feet)
Principal Arterial	500*
Arterial/Boulevard	400*
Collector	300*
Community Street	150
Local Queuing	100
Local Lane/Minor Access	100
* The Engineer may permit a minimum spacing of not less than 300-feet (Principal Arterial), 200-feet (Arterial/Boulevard), 200-feet (Collector) when findings are made to establish that:	
1. Without the change there could be no public street access from the parcel(s) to the existing street, or	
2. The change is necessary to support local pedestrian/bicycle circulation and access; and the change is necessary due to topographic constraints; and all other provisions of the street design requirements can be met.	

6.02.11 Curb Return Radius

Curb return radius at street intersections shall be designed to accommodate all expected traffic. Curb extensions and/or special crosswalk/sidewalk features designed to enhance pedestrian safety may be required to encourage pedestrian usage.

The minimum allowed curb return radii between intersecting streets are shown below. The minimum radii are based on the lowest classification of the 2 intersecting streets. For example, if a minor arterial intersects a neighborhood collector, the minimum turning radius for the 4 intersection corners should be 25-feet as displayed on the neighborhood collector row. If the intersection corner has on-street parking or bicycle lanes, the minimum radii can be reduced by 5-feet.

Minimum Curb Return Radii (Feet) Edge of Pavement/Curb	
Lowest Street Classification of 2 Intersection Streets	Minimum Curb Return Radius
Principal Arterial	30
Arterial	30
Boulevard	30
Collector	25
Community Street	25
Local Transitional	20
Local Queuing	20
Local Lane	15
Minor Access Street	15

If bicycle lane or on-street parking exists, above turning radii may be reduced by 5-feet, and in Special Plan Districts such as Downtown, Gresham Civic Neighborhood, and Rockwood.

Streets with heavy truck movements may be required to install larger curb radii than shown in the table. The Engineer will provide direction in deciding if an area needs larger than minimum turning radii at specific intersections. When designing turning radii higher than the minimums, the Engineer will identify the design vehicle

to be applied. Streets with daily transit routes shall not have curb return radii less than 25-feet to accommodate safe bus turning movements.

6.02.12 Parking

Street Class	Parking Lanes	Parking Required
Principal Arterial	None	Not allowed
Boulevard	None	May be allowed or required in town centers, regional centers, or adjacent to mixed use districts
Collector	2	Variable (1)
Community	2	Yes
Local Transitional	2	Yes (2) (3) (4)
Local Queuing	2	Yes (2)
Local Lane	None	Not Allowed (5)
Minor Access Street	None	Not Allowed (5)
(1) Collector – no parking within 45-feet of curb return		
(2) Local – no parking within 30’ feet of curb return		
(3) Local Streets in the Hillside Constraint District that are approved for reduced 40-foot right-of-way and 28-foot pavement will be required to have one parking lane; to assure that on-street parking is adequate for adjacent uses, a reduced street design will consider clustered parking bays adjacent to the street, if needed.		
(4) Cul-de-sac – no parking allowed within the 35-foot radius cul-de-sac turnaround		
(5) One additional off-street parking space is required for each residential unit that accesses a local lane or minor access street.		

For streets designated collector and below, the Manager may consider design modifications to conserve major trees in the public right-of-way. Subject to approval by the Manager, parking lanes may be removed on one or on both sides of a street.

6.02.13 Local Street Design for Adverse Topography

Local streets shall have a cross-section slope of 2.0% (“crown”) in accordance with Standard Detail 500, except in situations of adverse topography. When approved by the Engineer, the Engineer of Record may utilize an “offset” or unequal crown section when the existing ground slope exceeds 8.00% across the roadway section.

The offset crown design shall meet the following conditions:

1. Minimum distance from “crown” to (one) face of curb is 10.00-feet.
2. Maximum cross-slope of pavement is 5.00%, except for horizontal curves. On horizontal curves, maximum reverse superelevation is 2%.
3. Maximum differential in top of curb elevation from one side to the other is 1.00-foot.

The existing ground “side-slope” criteria are based on the relationship of the slope of the ground to the transverse slope of the roadway profile. This relationship shall be met for the entire length of the roadway alignment utilizing an offset crown. Other non-standard cross-sections such as “shed roof”, “saw tooth”, etc., may also be approved by the Engineer.

6.02.14 Streetlighting

A complete streetlighting system shall be the responsibility of the developer. All streets fronting the property and pedestrian accessways shall be provided adequate lighting as determined by the City. For lighting

requirements, all developments will be required to submit a lighting plan to the Project Manager. The lighting plan shall conform to IESNA RP-8 (Illuminating Engineering Society of North America) American National Standard Practice for Roadway Lighting.

Streetlights shall conform to Standard Details 636 through 640. Decorative lights, per Standard Detail 637, are required in the Gresham downtown districts. Infill development utilizing existing utility poles may be designed in accordance with Standard Detail 640.

6.02.15 Street Trees

Street trees in the public right-of-way, or within the setback and/or buffer area immediately adjacent to the right-of-way, will be required of all developments. The particular species will be reviewed and approved as part of overall project submittals. A deposit for street trees to assure installation of the trees prior to occupancy may be required at the time of building permit issuance.

Minimum caliper of street trees shall be 1¾-inch. Street trees shall not be located within the portion of the clear vision area approaching an intersection. Street trees located in the portion of the clear vision area leaving the intersection shall be a minimum of 2-inch caliper and a minimum of 8-feet head height at time of planting. Newly-planted trees shall be securely staked for the first 2-years after planting and shall be replaced if they die or are destroyed.

Tree Spacing	
Principal Arterial	30-feet
Boulevard	30-feet
Collector:	
Residential	30-feet (2 min. – 3 min. if corner lot)
Commercial	20-feet (2 min. – 3 min. if corner lot)
Industrial	20-feet
Community:	
Residential	30-feet (2 min. – 3 min. if corner lot)
Commercial	20-feet (2 min. – 3 min. if corner lot)
Industrial	20-feet
Local Transitional:	
Residential	30-feet (2 min. – 3 min. if corner lot)
Commercial	20-feet (2 min. – 3 min. if corner lot)
Industrial	20-feet
Local Queuing /Local Lane/Minor Access	30-feet (2 min. – 3 min., if corner lot)
Notes: (1) Spacing required may vary depending on site and/or topography constraints.	
(2) Distances include linear section of cul-de-sac.	
(3) Street trees shall be located at least 15 feet from streetlights and stormwater catch basins and at least 5 feet from driveway cuts and underground utilities.	

Recommended Street Trees

Trees for a 2-foot to 4-foot planting strip:

Paperbark Maple*
 Allegheny Serviceberry*
 Crimson Cloud Hawthorn*
 Adirondack Crabapple*
 Red Jewel™ Crabapple*
 Japanese Tree Lilac*
 Ivory Silk Tree Lilac*

Trees for a 3-foot to 6-foot planting strip:

Hedge Maple*
Rocky Mountain Glow® Maple*
Columnar Norway Maple
Crimson Sentry Norway Maple*
Olmstead Maple
Apollo® Maple*
Lavalle Hawthorn*
Flowering Ash
Golden Desert® Ash*
Professor Sprenger Crabapple*
Tschonoskii Crabapple
American Hophornbeam
Newport Plum*
Columnar Sargent Cherry*
Pink Flair™ Cherry*
Royal Burgundy Cherry

Trees for 4-foot planting strip or wider:

Queen Elizabeth™ Maple
Easy Street™ Maple
Superform Maple
Bowhall Maple
New World Maple
Scarlet Sentinel® Maple
Norwegian Sunset® Maple
Pacific Sunset® Maple*
European Hornbeam
Pyramidal European Hornbeam
Frans Fontain Hornbeam
Skyline® Ash
Tricolor Beech
Autumn Gold Ginkgo
Princeton Sentry® Ginko
Saratoga Ginkgo
Skyline® Honeylocust
Kwanzan Cherry* (on a 6-foot minimum graft)
Cleveland Select Pear
Chanticleer® Pear
Forest Green® Oak
Pyramidal English Oak
Skyrocket® Oak
Chancellor® Linden
Mushshino Zelkova
Wireless™ Zelkova*

Trees for 6-foot planting strip or wider:

State Street™ Maple
Veriegated Norway Maple
Cleveland Norway Maple
Parkway® Norway Maple
Emerald Queen™ Norway Maple
Globe Norway Maple*
Wineleaf Sycamore Maple
Sycamore Maple
Armstrong Maple

Brandywine Maple
 Embers Red Maple
 Red Sunset® Maple
 Morgan Maple
 Northwood Maple
 October Glory® Maple
 Scanlon Red Maple
 Schlesinger Maple
 Sun Valley Maple
 Green Mountain® Maple
 Hackberry
 Katsura Tree
 Yellowwood
 Empire Ash
 Autumn Purple® Ash
 Summit Ash
 Urbanite Ash
 Marshall's Seedless Ash
 Patmore Ash
 Shademaster® Honeylocust
 Skyline® Honeylocust
 Halka™ Honeylocust
 Moriane Sweetgum
 Black Tupelo*
 Yoshino Cherry*
 Rancho Pear
 Trinity Pear
 Scarlet Oak
 Skymaster® Oak
 Redmond Bigleaf Linden
 Rancho Linden
 Glenleven Linden
 Greenspire® Linden
 Frontier Elm
 Accolade™ Elm
 Triumph™ Elm
 Green Vase® Zelkova
 Halka Zelkova
 Village Green Zelkova

Trees for 8-foot planting strip or wider:

Schwedler Norway Maple
 Canoe or Paper Birch
 Purple Rivers Beech
 Kentucky Coffee Tree
 Tulip Tree
 Dawn Redwood
 Red Oak

*Trees that may be planted under power lines

6.02.16 Street Names and Traffic Control Signage and Striping

Street names for all new development will be approved by the City prior to recording of any maps or plats. Street names and building numbers shall conform to the established grid system(s) in the City and metropolitan area. No new street name shall be used that will duplicate or be confused with the name of existing streets in the metropolitan area.

The development shall pay for all street name and traffic control signage prior to the signing of the final plat or map by the City. All new signage will be installed by the City. A “signage and striping plan” shall be included with plan submittals for new street construction and approved by the Engineer.

6.03 ALLEYS AND PRIVATE RESIDENTIAL STREETS/ACCESSWAYS

6.03.01 Alleys

Alleys – Commercial and Industrial:

Alleys may be provided in commercial and industrial developments with approval of the Engineer. When approved, alleys shall be dedicated to the City. The right-of-way width shall be 20-feet with a 20-foot pavement width.

Design for alleys shall meet the same criteria as other public streets. Centerline radius and design speed may be the exception to those criteria when approved by the Engineer. Generally, alleys shall be designed for one-way.

Alleys – Residential Districts:

To serve development alleys allow for efficient lot use, support front yard pedestrian orientation and landscape spaces, and reduced lot coverage by driveways. Alleys serve as a common driveway for access, utilities, and deliveries.

1. **Limits:** Alleys must be constructed continuously from one street to a parallel or intersecting street. All lots must have frontage to a public street. If there are parking restrictions on the public street, additional parking spaces must be provided off of the alley.

2. **Pavements:** The standard design for residential district alleys shall consist of 12-feet of pavement within a 15-foot right-of-way. Pavement may drain to the center with an inverted crown upon approval by the Engineer.

6.03.02 Private Residential Streets

In general, private residential streets and accessways shall be provided for multi-family developments such as condominiums and apartments. “PRIVATE STREET” signage and driveway approach shall be placed at the intersection with the public street to clearly identify the private accessway.

6.04 DRIVEWAYS

Access to private property shall be permitted with the use of driveway curb cuts where curbs exist and with AC connections where no curbs exist. The access points with the street shall be the minimum necessary to provide access while not inhibiting the safe circulation and carrying capacity of the street. Driveways shall meet all applicable guidelines of the Americans With Disabilities Act (ADA).

On arterial and collector streets and above, one driveway per site frontage will be the normal maximum number. Double frontage lots and corner lots on these streets may be limited to access from a single street, usually the lower classification street. Commercial developments with frontage greater than 250-feet may request an additional driveway if needed. If additional driveways are approved by the Engineer, a finding shall be made that no eminent traffic hazard would result, impacts on through traffic would be minimal, projected travel demands indicate it is in the interest of good traffic operations, and adequate street frontage exists to meet the driveway spacing standards of this section. Restrictions may be imposed on additional driveways, such as limited turn movements, shared access between uses, closure of existing driveways, or other access management actions.

A new driveway will not be allowed (measured to the driveway centerline):

1. Within 30-feet of any commercial property line except when it is a shared-use driveway serving 2 or more abutting properties;
2. Within 100-feet of the right-of-way of an intersecting arterial street;
3. Within 50-feet of the right of way of a non-arterial street;
4. When adequate sight distance cannot be provided.

Residential curb cuts shall be a minimum distance from adjacent property lines such that driveway curb wings and ramped sidewalk do not encroach on adjacent properties. Exceptions are allowed for shared driveways or when the lot is platted as a zero lot line or as an attached single-family lot.

DRIVEWAY LOCATIONS			
Street Classification	Residential	Commercial	Industrial
Principal Arterial	100 feet ^{1,3}	100 feet ¹	100 feet ¹
Arterial	100 feet ^{1,3}	100 feet ¹	100 feet ¹
Boulevard	100 feet ^{1,3}	100 feet ¹	100- feet ¹
Collector	45 feet ³	100 feet ¹	100 feet ¹
Community	45 feet ^{2,3}	100 feet ¹	100 feet ¹
Local Transitional	45 feet ²	45 feet	45 feet
Local Queuing	45 feet ²		
Minor Access	45 feet ²		
Notes: 1. Minimum distance from curb return unless this prohibits access to the site.			
2. Corner lot driveways on a frontage that is less than 75-feet shall be located no more than 8-feet from the interior property line and shall be no more than 24-feet wide.			
3. Direct access to this street may not be allowed if an alternative exists or is planned.			

DRIVEWAY WIDTHS (Minimum/Maximum) IN FEET			
Street Classification	Residential	Commercial	Industrial
Principal Arterial	N/A ¹	12/36	12/36
Arterial	12/24 ²	12/36	12/36
Boulevard	12/24 ²	12/36	12/36
Collector	12/24 ²	12/36	12/36
Community	12/24 ²	12/36	12/36
Local Transitional	12/24 ^{2,4}	12/36 ³	12/36 ³
Local Queuing	12/24 ^{2,4}	N/A	N/A
Minor Access	12/24 ^{2,4}	N/A	N/A
Notes: 1. Special conditions may warrant access.			
2. 28-foot maximum with 3-car garage (3 bays wide).			
3. Build to community street standard.			
4. In the LDR District, the maximum width is 16-feet on interior lots with less than 45-feet of street frontage. Corner lots accessing the street with less than 36-feet of street frontage as measured from the curb return to property line are limited to a 12-foot driveway width.			

For classification of collector and above, driveways adjacent to street intersections shall be located beyond the required queue length for traffic movements at the intersection. If this requirement prohibits access to the site, a driveway with restricted turn movements may be required.

Within commercial, industrial, and multi-family areas, shared driveways and internal access between similar uses are encouraged to reduce the access points to the higher classified roadways; to improve internal site circulation; and to reduce local trips or movements on the street system. Shared driveways or internal access between uses will be established by means of common access easements at the time of development.

6.05 SIDEWALKS

In general, new sidewalks with curbs are required for all development requiring a development permit. Sidewalks shall be buffered from the roadway to provide for the safety and comfort of pedestrians.

6.05.01 SIDEWALK WIDTH

Street Class/Location	Sidewalk Width	Approximate Planter Strip Width
Principal Arterial	8-feet	6-feet
Arterial	6-feet	4-feet
Boulevard	11-feet	4-feet
Collector	6-feet	4-feet
Community	6-feet	4-feet
Local Transitional	5-feet	3.5-feet
Local Queuing	5-feet	4-feet
Local Lane	5-feet	N/A

Sidewalks shall be installed such that back of walk is 6-inches inside the right-of-way, except in cases where buildings abut the right-of-way in which cases the sidewalk will abut the building.

Sidewalks may meander within the dedicated right-of-way or outside of the right-of-way within an easement with the approval of the Engineer.

Sidewalks shall have a maximum cross slope no greater than 1:50. Sidewalks shall be constructed with a continuous passage of 5-feet clear of all obstructions, including poles, mailboxes, signposts, etc. With the Engineer's approval, utilities with facilities in the sidewalk may locate their facilities to be in conformance with a 36-inch minimum horizontal clearance. A 7-foot vertical clearance above the sidewalk shall be maintained.

Include handrails or fences to protect pedestrians when there is a vertical drop of 30-inches or greater adjacent to sidewalk.

6.05.02 Sidewalk Ramps

New street intersections shall incorporate 2 sidewalk ramps per corner, unless approved otherwise by the Project Manager. Retrofits shall incorporate ramps that line up with existing ramps, typically a single diagonal ramp. Where ADA ramps are non-existent opposite new ramps installed as part of new frontage construction, new ramps shall be constructed on the other side of the street in addition to the new ramps constructed as part of the frontage. Sidewalk ramps shall meet all applicable guidelines of the Americans with Disabilities Act (ADA), except as noted herein.

Locations of sidewalk ramps shall be designed with regard to stormwater flows, street grades, and pole locations. Other factors may also dictate sidewalk ramp location.

In areas of existing steep terrain, the City encourages the Engineer of Record to:

- Utilize existing code provisions to eliminate sidewalk on one side of the street when permissible. This is permitted by development standards and will reduce the overall number of ADA ramps. However, designer will need to provide continuity in the pedestrian network.
- Utilize existing standards that allow the flexible use of either one or two ADA ramps per corner.

The City will review cross slopes on construction plans as follows:

- For street grades of less than 8%, cross slopes shall not exceed 2%.
- For street grades equal to or greater than 8%, cross slopes of up to 5% will be permitted if considered reasonable in the engineering judgment of the City.
- Cross slopes greater than 5% may be proposed in cases of technical infeasibility and will only be permitted if considered reasonable in the engineering judgment of the City.

The City will not approve cross slope more than 2% in advance of the submittal of construction plans. Written construction plans must be submitted to, reviewed, and approved by the Engineer prior to construction.

There may be rare cases in which circumstances justify a cross slope greater than 5%. The City will permit such cross slopes only if, in the exercise of the City's reasonable engineering judgment, the City determines that there are no other practical alternatives. The following considerations will apply to the exercise of reasonable engineering judgment by the City:

- For cross slope of greater than 5%, the Engineer of Record must state that every effort has been made to design a project with 5% cross slopes. Rough plans showing 5% cross slopes must be submitted with additional information to identify why the plan is not a practical alternative.
- City approval shall include a disclaimer that City approval will not act as an agreement or obligation to indemnify anyone if an ADA violation is alleged.
- The Engineer will consider the following factors in determining whether allowing a cross slope greater than 2% is a reasonable exercise of engineering judgment.
 - Street grades and width
 - Anticipated vehicle speeds
 - The nature of intersection controls
 - Alternative accessible routes
 - Permitted land uses in the area
 - Impact on natural resources

The engineering judgment will be documented by the Engineer and approved by the Transportation Manager. If the cross slope exceeds 5%, the DES Director's approval of the engineering judgment must also be obtained. See Standard Details 626 and 627 for additional details.

6.06 BICYCLE FACILITIES

The City has adopted the "Gresham Bicycle/Pedestrian Plan." This plan summarizes the City's policy and implementation strategies for bikeways within the City and for connection with metropolitan bikeways. The City's plan has adopted both AASHTO and ODOT standards and criteria as the minimum guidelines for bikeway design, construction, and control.

The City's adopted guidelines for bikeways consist of the following:

1. AASHTO, "Guide to Development of Bicycle Facilities" – latest edition
2. ODOT, "Oregon Bicycle & Pedestrian Plan" – latest edition
3. Manual on Uniform Traffic Control Devices with Oregon supplements by Oregon Transportation Commission – latest edition

6.06.01 Bikeway Location Width

Bikeway Location		Width	Comments
Public Street (designated bike lane)		6-feet ¹	Each direction of travel at shoulder/curb
Note:	1.	The 6-foot section is required unless this width is not practical because of physical or economic constraints as approved by the Manager. In the aforementioned case, a minimum width of 4-feet may be designated as a bicycle lane.	

6.06.02 Pedestrian/Bicycle Accessway

Accessways are subject to the following design standards.

All rights-of-way for pedestrian and bicycle accessways shall be dedicated to the City for public use or may be approved as public access easements on private property. Accessways shall be maintained as part of the public right-of-way or by the underlying landowner if constructed as public easements over private land.

Right-of-way or easement width shall be 10-feet except that a 15-foot width is required for accessways that also provide for public utility corridors. Also, if an accessway provides secondary fire access, a minimum 20-foot width is required.

The Engineer may approve accessways exceeding 200-feet in length if there is adequate right-of-way or easement width to provide for safe pedestrian and bicycle travel.

A clear-vision triangle, as specified in GCDP Section 9.0200, shall be provided at the ends of all accessways. Accessways shall be straight enough to allow both ends of the accessway to be seen from the adjacent public streets and lighting must be provided. On-street parking shall be prohibited within 15-feet of the intersection of an accessway and a public street to preserve safe sight distance.

The construction of stairways shall be avoided whenever possible. Where the path grade would exceed 12% slope, an accessway will be constructed as stairs for pedestrians. Based on local conditions, the Manager may approve alternatives to stairs, including the use of switchbacks and alternative materials. If stairways are needed, they shall be at least 5-feet wide with handrails on both sides.

When required for buffering, accessways shall be fenced and screened along adjacent property lines. The area between the pathway and fences shall be planted with a combination of groundcover or low-growing shrubs that will reach no more than 2-feet high at maturity.

Accessways shall be designed to prohibit motorized traffic.

Off-street pedestrian/bicycle accessways shall be constructed for 2 different situations – where no vehicular use will occur and where heavy maintenance vehicle use will occur. In both cases, subgrade preparation will require removal of existing organic material in accordance with roadway construction.

When drainage such as side ditches is required parallel with the bikeway, the ditch centerline shall be at least 5-feet from the edge of the pavement and additional right-of-way or easement width may be required. Ditch side slope adjacent to the bikeway shall be no steeper than 2:1 when measuring the horizontal distance to the vertical distance.

When accessway crosses culverts, the ends of the pipe shall be no closer than 5-feet from the edge of the accessway.

Erosion Prevention and Sediment Control Manual

City of Gresham, Oregon



Stormwater Division
Department of Environmental Services
1333 NW Eastman Parkway
Gresham, Oregon 97030-3813



January 2006

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Chapter 1 Introduction

1.0 Introduction

The City of Gresham is committed to enhancing, protecting and maintaining the livability of the community and the quality of the water. Within the jurisdictional boundaries of the City of Gresham, sensitive areas include, but are not limited to, the Columbia Slough and Johnson, Fairview, and Kelly Creeks and their tributaries.

Based on the fact that the stream's within the city limits are listed as degraded on the state's water quality limited streams 303 (d) list, one of the City's primary goals is implementation of an erosion prevention and sediment control program that prevents sediment and other stormwater pollutants from entering streams.

This *Erosion Prevention and Sediment Control Manual (Manual)* has been prepared to support development of stormwater best management practices (BMPs) for construction sites required to comply with the NPDES 1200-C General Permit, current state turbidity rule, and City of Gresham requirements for small and large projects. Keep in mind that City requirements may be more stringent than DEQ requirements.

EPSC measures are required on all construction sites that disturb soil within the City of Gresham.

1.1 Objective of the Manual

This *Manual* provides users with a standardized set of procedures and tools: best management practices (BMPs) for implementation on construction projects throughout the City of Gresham. When appropriately designed and implemented, the BMPs will reduce water quality impacts by land-disturbing activities.

The authority for this Manual is derived from the *Gresham Community Development Code (GDC)*, *Gresham Revised Code (GRC)*, and the *Gresham Public Works Standards (GPWS)*, which directs users on compliance with the Oregon Department of Environmental Quality's National Pollutant Discharge Elimination System (NPDES) stormwater permitting program, specifically 1200-C.

The City of Gresham requires an Erosion Prevention and Sediment Control Plan for most construction activities and an NPDES 1200-C permit for site disturbance of one acre or more.

This Manual provides detailed and comprehensive direction for the engineers and designers in the construction industry, contractors, and other potential permittees and applicants to facilitate effective implementation and maintenance of erosion and sediment control measures. Permit applicants will find the necessary information for complying with City of Gresham procedures for Erosion Prevention and Sediment Control Plans and builder responsibilities.

1.2 How to Use this Manual

At the time of writing, this *Manual* provides the most up-to-date erosion prevention, runoff, and sediment control best management practices (BMPs) that are considered

effective by the State and the City. The *Manual* assists with the identification and implementation of BMPs appropriate for site specific conditions and is for use by design and construction professionals involved with the planning, design, construction, and oversight of projects..

Approval of an Erosion Prevention and Sediment Control Plan by the City does not relieve the applicant of responsibility to ensure that control measures are constructed and maintained to contain sediment on the construction site.

Personnel that do not have extensive expertise in designing and implementing erosion and sediment control measures will benefit from review of the entire *Manual*. Personnel that have previous experience with the planning, design and implementation of construction stormwater BMPs may benefit primarily from the information provided in individual BMP details.

Chapters 2 and 3 are designed to aid users of this *Manual* through the initial BMP selection process. The process is simplified for single-family/duplex residential construction (Chapter 2). More options are available for addressing larger and more complex development projects (Chapter 3). Users are allowed to choose between some practices, but are required to implement others. Monitoring, maintenance, and enforcement of BMPs are covered in Chapter 4. Details of each BMP are coded by category and found in Chapter 5. The reader will find BMPs arranged and described by their primary role in pollution discharge elimination processes; that is, erosion prevention, sediment control, and runoff control. Usually, users select a combination of BMPs from multiple categories to provide layers of insurance for their site. Throughout the selection process, users should take into account the benefits and limitations of each BMP considered. BMP success is contingent not only on appropriate design and implementation, but on proper maintenance and the coordination and communication between the designers, engineers, and the field construction teams. Finally, Chapter 6 describes non-stormwater pollution controls to address potential pollution pathways at construction sites.

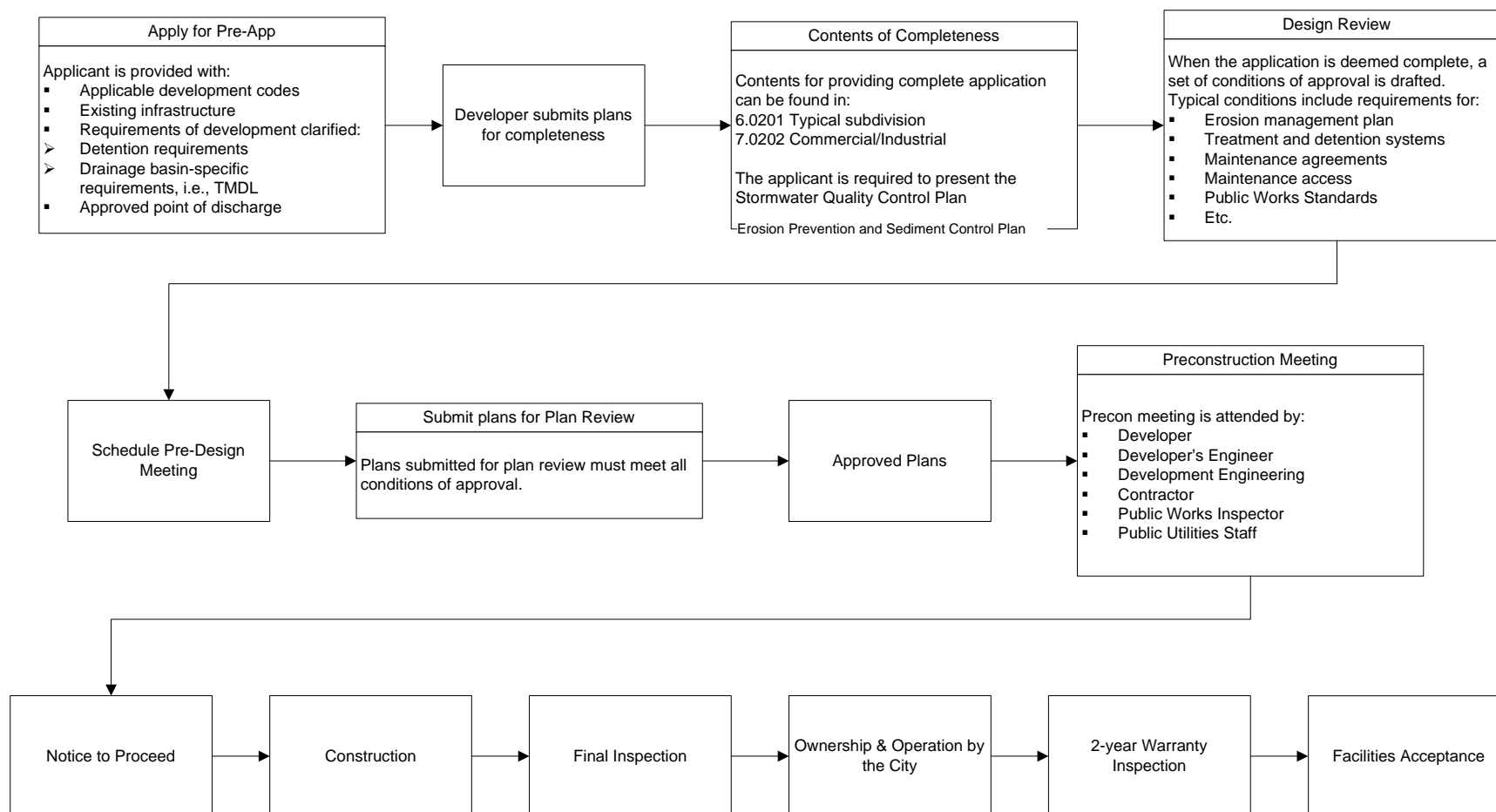
Owners and permittees must ensure their actions do not degrade water quality or harm threatened or endangered species, and shall implement conservation measures to avoid and minimize potential adverse effects.

Refer to the following flow chart titled, “Development Process Overview,” to review the City’s permit approval process. To review the permit approval process timeline, refer to GDC Section 11.0211 through 11.0217.

Periodic updates to this *Manual* will be made as materials, practices, and policies change within the industry and are made available.

The contents of this *Manual* should not be interpreted as necessarily representing the policies or recommendations of other referenced agencies or organizations. Furthermore, the mention of trade names, products, equipment, or manufacturers is not an endorsement by the City of Gresham. Manufacturer trade names appear here only when considered essential to the educational objectives of the *Manual*.

Figure 1.2.1 Development Process Overview



This Development Review Process flowchart represents a very simplified version of actual process. It is limited to this Manual and is an overview only. It is not meant to replace or supersede other process and/or permitting needs not mentioned but required.

Chapter 2 Single-Family/Duplex Development

2.1 Overview

This chapter describes the requirements for preparing Erosion Prevention and Sediment Control Plans (Plans) for new single-family and duplex construction requiring a building permit.

2.2 Requirements

It is the responsibility of the permit holder to keep sediment on-site. Plans shall describe ways to minimize the discharge of pollutants in runoff from any construction activity, using erosion prevention, and sediment, runoff, and non-stormwater pollution control BMPs.

The Plan designer shall incorporate information and observations obtained from the City, applicable resource agencies, and a site visit. In addition, the designer must identify potential erosion and sediment problems, develop design objectives, formulate and evaluate alternatives, select best erosion prevention measures, and develop a Plan.

The permit holder shall designate a person with erosion prevention and sediment control experience. The designated person, whether contractor or erosion and sediment control specialist, has a defined responsibility to prevent sediment from leaving the site. The designee must follow the Plan, or make approved revisions to the plan as necessary, and ensure that the site is stable. Although a permitted Plan may appear to have addressed all issues, the designer shall adapt the plan during implementation to ensure proper performance.

The Plan shall be submitted with the building permit application.

The City of Gresham does not require that a registered engineer prepare the Plan for single-family/duplex construction, unlike development projects over 20 acres in size.

See Chapter 4 for required maintenance & inspection practices.

2.3 Minimum BMPs for Single-Family/Duplex Projects

Minimum BMPs for single family or duplex permitted projects are listed in Table 2.3.1. Minimum BMPs for all other development are listed in Table 3.4.1.

Note that wet season construction requires augmented protection measures. If planned dry season construction becomes delayed into the next wet season, the Plan must be revised to include at least the minimum wet season BMPs.

TABLE 2.3.1. MINIMUM BMPs FOR ALL SINGLE-FAMILY/DUPLEX PROJECTS

Best Management Practice ¹	Code ²	Year Around	Wet Season ³
Linear Barrier and Perimeter Control	SC-1 to SC-7, SC-12	✓	
Storm Drain Inlet Protection	SC-8	✓	
Construction Entrance/Exit Tracking Controls	NS-5/ SC-10	✓	
Non-Soil Stockpile Management	NS-9	✓	
Concrete Management	NS-14	✓	
Inspection and Maintenance	All	✓	
Soil Stockpile Management	EP-22	✓	
Temporary Seeding and Planting/ Permanent Seeding and Planting	EP-5/ EP-6	✓	✓
Slope Breaks for Steep Slopes	SC-5 to SC-7, RC-4	✓	✓

¹ See also Appendix E: Costs and Suppliers for additional information. BMPs not included in this *Manual* may be submitted to the City for consideration.

² Codes correspond to BMP details in Chapters 5 and 6 of this *Manual*.

³ Additional measures required from October 1 to May 31.

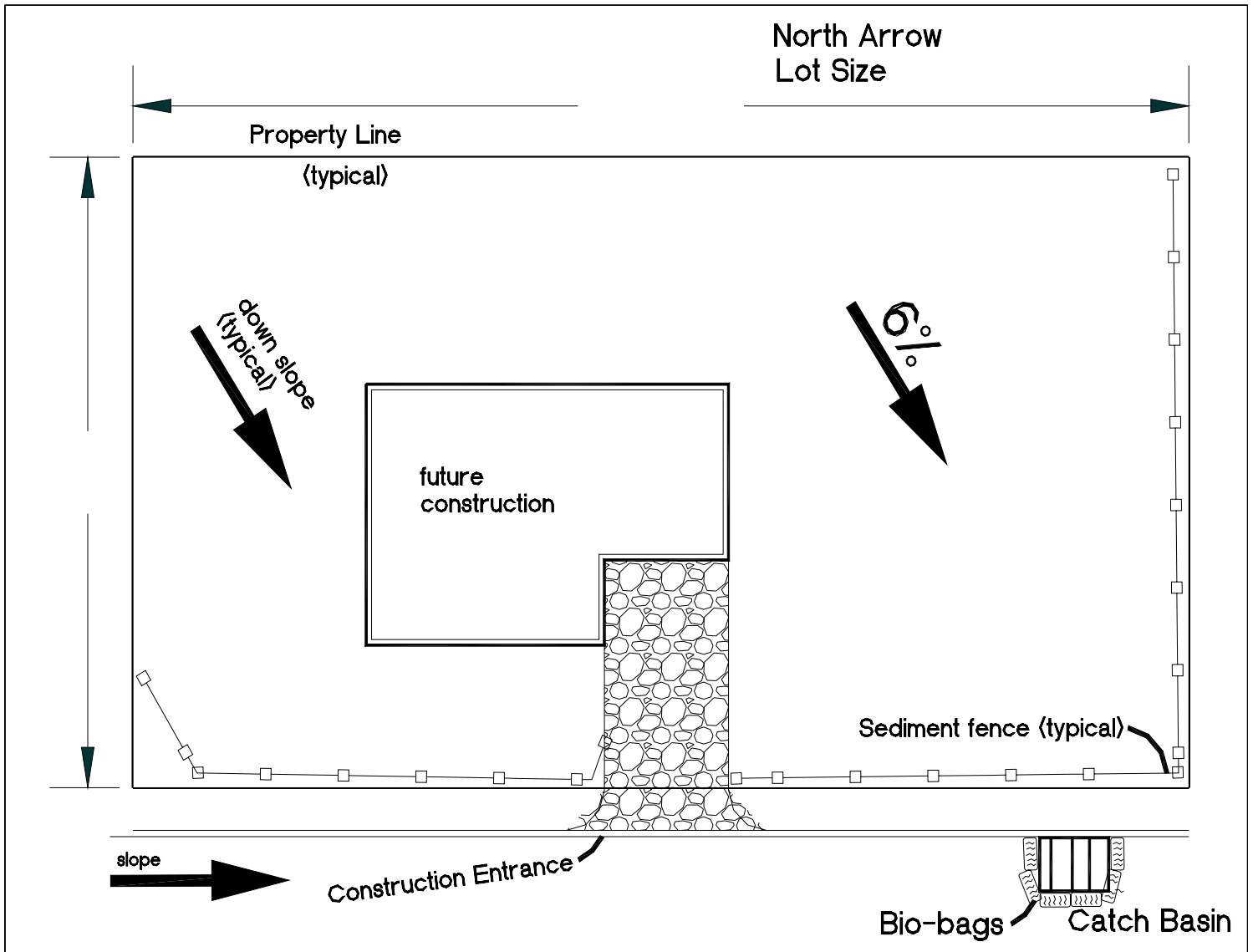
2.4 Site Plan Checklist

Table 2.4.1

Site plan must include the following:

- ☐ Provide the name and phone number of the person(s) responsible for erosion prevention and sediment control on site.
- ☐ Site contours and/or drainage patterns found on the site—identify any slope greater than 5%.
- ☐ Location and maintenance schedule of erosion prevention and sediment control measures to be used on site. Including but not limited to:
 - Gravel construction entrance
 - Sediment barrier: downslope side of the site along contours
 - Stormdrain inlet protection
- ☐ Between October 1 and May 31 notes describing additional wet weather BMPs to be utilized and ground cover.

FIGURE 2.4.1 EXAMPLE SITE PLAN



Chapter 3 All Other Development

3.1 Overview

This chapter describes the requirements for preparing Erosion Prevention and Sediment Control Plans (Plans) for all private and public development projects, except single-family and duplex construction. These projects include new construction on existing lots of record and additions to existing developments that require a City building or grading permit.

3.2 Requirements

It is the responsibility of the permit holder to keep sediment on-site. Plans shall describe ways to minimize the discharge of pollutants in runoff from any construction activity, using erosion prevention, and sediment, runoff, and non-stormwater pollution control BMPs.

The Plan designer shall incorporate information and observations obtained from the City, applicable resource agencies, and a site visit. In addition, the designer must identify potential erosion and sediment problems, develop design objectives, formulate and evaluate alternatives, select best erosion prevention measures and develop a Plan.

The City of Gresham requires that all projects include an EPSC Plan. Projects over 20 acres must include a Plan prepared by a registered engineer.

The permit holder shall designate a person with erosion prevention and sediment control experience as the EPSC Manager. The designated person, whether contractor or erosion and sediment control specialist, has a defined responsibility to prevent sediment from leaving the site. The designee must follow the Plan, make approved revisions to the Plan as necessary, and ensure that the site is stable with no visible sediment discharges. Although a permitted Plan may appear to have addressed all issues, the designer shall adapt the Plan during implementation to ensure proper performance.

3.2.1 Standard Notes

The following requirements shall be included on all Plans:

- The owner/permittee, or EPSC Manager, shall be responsible for proper installation, monitoring, maintenance, and removal of all erosion prevention and sediment control measures, in accordance with the city, state, and federal regulations. Responsibility will continue until permanent vegetation or landscape is complete. Owner/permittee shall be responsible for maintenance until the following conditions are met: 1) the project has been accepted by the City; 2) all individual lots are sold; and 3) termination of the 1200-C permit by the Department of Environmental Quality (DEQ).
- Approval of the Plan does not constitute an approval of permanent road or drainage design (e.g., size and location of roads, pipes, restrictors, channels, retention facilities, utilities).
- The boundaries of the clearing limits shown on a Plan shall be clearly marked in the field prior to construction. During the construction period, no disturbance beyond the clearing limits shall be permitted. The markings shall be maintained by the owner/permittee or designee for the duration of construction.

- The EPSC BMPs shown on the Plan must be constructed in conjunction with all clearing and grading activities, in accordance with the conditions of approval, public works standards, development code, and in such a manner as to ensure that sediment, sediment-laden water, and other pollutants do not enter the drainage system or roadways, or violate applicable water quality standards.
- The EPSC BMPs shown on the Plan are minimum requirements for anticipated site conditions. During the construction period, the BMPs shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment laden water do not leave the site.
- The EPSC BMPs shall be inspected daily during stormwater and snowmelt runoff and at least once every seven (7) calendar days and within 24 hours after any storm event that produces at least ½ of an inch of rain per 24-hour period. On inactive periods of greater than seven (7) consecutive calendar days, inspections are required every two (2) weeks.
- At no time shall sediment be allowed to accumulate more than one-third the height of any sediment control barrier. Trapped sediments shall be removed from catch basins when design capacity has been reduced by 50 percent. All catch basins and conveyance lines shall be cleaned prior to project final inspection. The cleaning operation shall not flush or intentionally wash sediment-laden water into the downstream stormwater system, streams or drainageways.
- Sediment that leaves the site shall be cleaned up within 24 hours and placed back on the site or properly disposed. Any in-stream clean up of sediment shall be performed according to requirements of the U.S. Army Corps of Engineers and the Oregon Department of State Lands.
- Storm drain inlets, catch basins, and area drains shall be protected until pavement surfaces are completed and permanent vegetation has been established.
- Stabilized gravel entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project.
- Concrete washout location shall be provided for washing of concrete trucks and equipment so that concrete slurry is not washed into the stormwater system, streams, or drainageways. Identify the location on the Plan and include the note: “Do not overfill and bury when finished.”
- Groundcover and/or seeding shall be completed as soon as practicable for each phase of construction and not later than September 1. If fertilizers are used to establish vegetation, the application rates shall follow manufacturer’s guidelines and the application shall be performed in such a way to minimize nutrient-laden runoff to receiving waters. The Plan shall state the conditions for determining successful vegetation establishment.
- Non-stormwater pollutant control measures including any use of toxic or other hazardous materials shall include proper storage, spill containment, application, and disposal.
- Wet weather measures shall be established by October 1st and continue to function through May 31st of the following year. Prior to discontinuing activities on any portion of

the site between October 1 and May 31, any exposed area shall be stabilized within 7 days to prevent erosion. Between June 1 and September 30, the site must be stabilized within 30 days. Stabilization may occur by applying appropriate cover (e.g., mulch, erosion control blankets, binders, tackifiers) or establishing adequate vegetative cover.

- Prior to final project acceptance by the City, the site shall be permanently stabilized (seed and mulch or tackifier, or permanent landscaping). See Appendix F: City of Gresham Native Plant Restoration Guide as a resource. For subdivisions, temporary groundcover will be accepted if home construction will begin within 30 days of project finalization.
- The owner/permittee is responsible for removing all sediment control measures once permanent stabilization has been established. DEQ will not terminate the 1200-C permit until permanent vegetation is established.

3.3 Minimum BMPs for All Other Development Projects

Regardless of size or type, the EPSCPs for all projects must contain a minimum set of BMPs. Minimum BMPs for all permitted projects, other than single-family or duplex projects, are listed in Table 3.3.1.

Note that wet season construction (Oct 1-May 31) requires augmented protection measures. If planned dry season construction becomes delayed into the next wet season, the Plan must be revised to include at least the minimum wet season BMPs.

In Gresham, all development projects must contain the minimum BMPs.

The minimum set of BMPs may not be adequate to prevent erosion and sediment discharges under all circumstances and site conditions. In these cases, the designer/builder must select additional BMPs for the Plan to address site-specific conditions. Approved BMPs to address runoff control, erosion prevention, and sediment control are described in Chapter 5.

Approved BMPs to address non-stormwater pollution control are described in detail in Chapter 6.

TABLE 3.3.1. MINIMUM BMPs FOR ALL OTHER DEVELOPMENT PROJECTS

Best Management Practice ¹	Code ²	Year Around	Wet Season ³
Linear Barrier and Perimeter Control	SC-1 to SC-7, SC-12	✓	
Storm Drain Inlet Protection	SC-8	✓	
Construction Entrance/Exit Tracking Controls/ Tire Wash, as required	NS-5/ SC-10/ SC-11	✓	
Non-Soil Stockpile Management	NS-9	✓	
Concrete Management	NS-14	✓	
Inspection and Maintenance	All	✓	
Soil Stockpile Management	EP-22	✓	✓
Temporary Seeding and Planting/ Permanent Seeding and Planting	EP-5/ EP-6	✓	✓
Slope Breaks for Steep Slopes (Temporary Interceptor Dikes and Swales)	SC-5 to SC-7, RC-4	✓	✓

¹ See also Appendix E: Costs and Suppliers for additional information. BMPs not included in this *Manual* may be submitted to the City for Consideration.

² Codes correspond to BMP details in Chapters 5 and 6 of this *Manual*.

³ Additional measures required from October 1 to May 31.

Table 3.3.2. PLAN REQUIREMENT CHECKLIST**The EPSC Plan submittal must include:**

- ☐ Cover sheet with a site location map.
- ☐ Proposed public and private stormwater system plan or composite utility plan.
- ☐ Final site stabilization or planting plan. (Refer to Appendix D: Conversion and Reference Tables)
- ☐ Completed EPSC plan as noted below.

Site Plan Checklist (Cont.)

The EPSC plan must include the following items:

- ☐ Name and number of the designated person responsible for erosion control
- ☐ Contour lines with elevations included on the plan extending 200 feet beyond the property line
- ☐ Adjacent natural resources, such as, streams, creeks, wetlands, ponds, drainage channels, lakes, and other sensitive areas.
- ☐ Identification of slopes, drainage patterns, and concentrated flows.
- ☐ Location of cuts and fills.
- ☐ Location of excavated materials storage.
- ☐ Identified clearing limits.
- ☐ Identified area for concrete truck and equipment cleanout.
- ☐ Location of gravel construction entrances.
- ☐ Locations of erosion prevention and sediment control BMPs (refer to Table 3.3.1 for minimum BMP requirements):
 1. Sediment control devices, such as, downslope barriers, slope breaks, inlet protection, and outlet protection.
 2. Erosion prevention devices, such as, temporary vegetation, matting, mulch, or other appropriate groundcovers.
 3. Runoff controls, such as, slope drains, temporary diversions, and check dams.
 4. Temporary/permanent detention facilities.
- ☐ Description of all non-stormwater pollution controls.

Site Plan Checklist (Cont.)

- ☐ Details and/or specifications for all proposed BMPs.
- ☐ Standard notes.
- ☐ BMP maintenance & inspection schedule.
- ☐ Construction schedule.

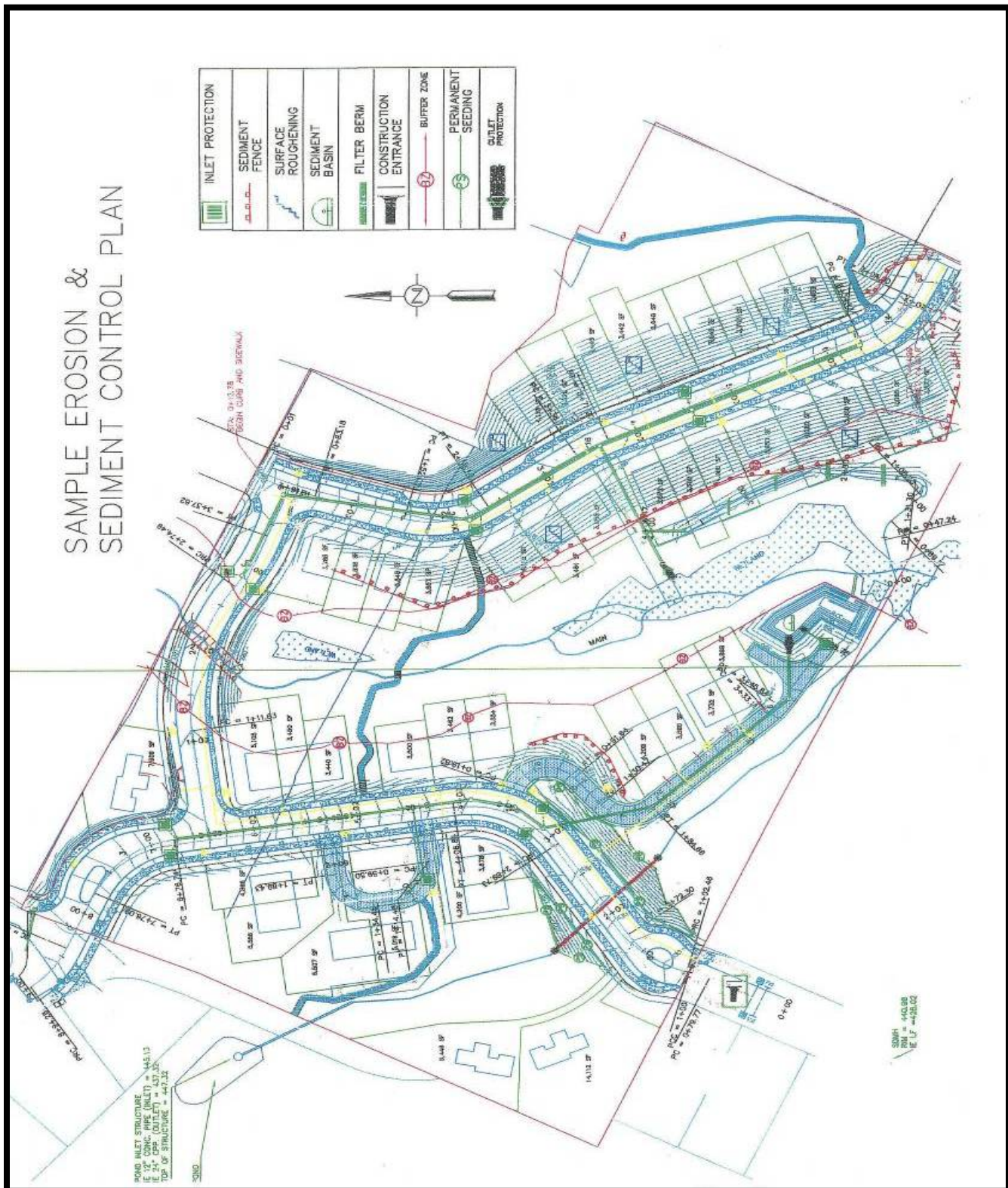
Wet Weather Plan Requirements (October 1 – May 31) must include the following items:

- ☐ Native vegetation, established temporary vegetation, such as seeding and mulch or mulch and tackifier, binders, or matting.
- ☐ Slope stabilization, such as horizontal tracking, terracing, temporary or permanent ground cover, interceptor dikes, or bioswales.

Additional Considerations:

- ☐ Remove the minimum necessary vegetation.
- ☐ Phase construction of the project.
- ☐ Intercept stormwater runoff and direct flow away from exposed soils to a stabilized outlet.
- ☐ Prepare for predicted rain events.

Figure 3.4.2 Sample Site Plan



Chapter 4 Inspection, Maintenance, and Enforcement

4.1 Overview

It is the intent of this chapter to outline the minimum requirements for both the City of Gresham and the Department of Environmental Quality (DEQ) as they pertain to inspection and maintenance.

This chapter presents site inspection requirements for the NPDES 1200-C General Permit as well as additional standards for conducting an initial site walk-through, vegetation monitoring, and reporting. Unless measures are properly installed and maintained per standards outlined in this section, failure will cause cleanup and restoration costs to escalate.

If other regulatory agency rules are violated, the City will notify the appropriate state or federal agency(ies).

4.2 EPSC Manager Requirements

The owner/permittee of the site shall designate a person to act as the EPSC Manager. The appointee must be experienced in erosion prevention and sediment control techniques as described in this *Manual*. The EPSC Manager shall be responsible for assuring the implementation of the Plan, as well as having the authority to immediately mobilize necessary personnel and equipment to correct and modify EPSC BMPs when required.

Duties of the EPSC Manager include:

Managing and ensuring proper implementation of the Plan including maintenance and repair of BMPs from both erosion and construction activity.

- Meeting with the City to review and update the Plan and to develop a schedule to ensure that appropriate controls are implemented and maintained during the wet weather periods.
- Ensuring that clearing limits shall be flagged in accordance with the approved EPSC and/or Grading Plan and that no ground disturbance is permitted beyond the flagged boundary.
- Ensuring that flagging is maintained for the duration of construction.
- Ensures the installation of appropriate perimeter control measures prior to any major site grubbing operation. Perimeter control measures include interceptor swales, berms and sediment fences along the outside edge of buffer zones and toes of slope.
- Purchasing, maintaining, and modifying EPSC BMPs as necessary to ensure overall performance is being met.
- Mobilizing crews to make immediate repairs to those measures or install measures during working and non-working hours.
- Recording actions taken to clean up significant amounts of sediment.

- Maintaining an up-to-date Plan throughout the life of the project.
- Overseeing the implementation of wet weather BMPs prior to Oct 1.
- Accompanying the City's representatives or other regulatory agents on inspections.

4.3 Pre-Construction Meeting

The pre-construction meeting provides an opportunity for the contractor to discuss the Plan with the City's inspector and discuss which elements of the Plan warrant the most attention. Adjustments to improve performance or make installation easier and maintenance more reliable may also be discussed. Implementing the Plan and assuring its performance may involve significant expense.

The following activities are required:

- Prior to the pre-construction meeting, review and comment on the Plan.
- During the pre-construction meeting, review all comments and concerns.
- Prohibit clearing and grading operations prior to Plan approval and implementation.
- Delineate clearing limits, drainage courses, easements, setbacks, wetlands, and other sensitive areas and their buffers.

Key points to consider in the pre-construction meeting are:

- Owner/permittee and contractor inspection schedule and procedures.
- Qualifications of the designated EPSC Manager.
- Method to be used to document the up-to-date Plan.
- Adjacent areas that need special protection from sedimentation, such as wetlands, stream crossings, and stormwater outlets.
- Pollution prevention considerations.
- Location of EPSC BMPs and their implementation.
- Sequence of installation with respect to the construction schedule.
- Surface stabilization plans (e.g., temporary and permanent seeding).
- Construction schedule and any anticipated shutdown periods.
- Maintenance plans and the contractor's procedure for monitoring performance.
- Location of all disposal areas.
- Emergency or contingency plans.
- Any special requirements identified in permits.

4.4 Modified EPSC Plan

The City approved Plan is only a guide and may not address all erosion problems for the project adequately. Therefore, it is the responsibility of the owner/permittee or designated EPSC Manager to monitor soil stability on site and propose modifications to the Plan as necessary. In addition, effective erosion control is closely tied to a contractor's staging, operation methods, and construction timing. When the Plan is developed, the contractor's staging and operation methods are unknown. Therefore, it is expected that the Plan will need to be updated throughout the life of the project. As modifications to the Plan take place, it is required to secure the approval of all permitting agencies.

Depending upon the level of modification, the design engineer is responsible for submitting those changes to the City and to DEQ for 1200-C permitted projects. Regardless of its magnitude, a contingency Plan must be implemented immediately. Minor modifications to the Plan, such as installing small sections of sediment control barriers, may be adjusted in the field and hand written, if necessary.

4.5 Construction Schedule Review

The implementation of the construction schedule must include the following:

- Timing of wet weather season work (October 1st through May 31).
- Timing of activities to meet "in-water" work restrictions. (Refer to Department of State Lands for in-water work periods).
- Sediment control measures shown on the plans shall be installed prior to ground-disturbing activities. Interior measures shall be installed as work progresses.
- Permanent facilities, such as detention facilities that will be used as temporary sediment ponds, shall be installed prior to grading.
- Timing of seeding operations.
- Retention of all sediment control measures until disturbed areas have been permanently vegetated or landscaped.

4.6 Inspection Form

Inspections shall be recorded on the Erosion Control Inspection Form (see sample form below). The effectiveness of each BMP at every location on site shall be documented on the form, and general site conditions observations shall be recorded as well. These forms shall be made available to agency staff upon request.

Information provided on the form is useful for tracking repairs and demonstrating permit compliance. It is noteworthy that in the event of permit violations or subsequent enforcement actions, the information recorded on the form, along with photographs and videos may be used to evaluate the responsibility of involved parties.

4.7 Installation

The owner/permittee (or designated EPSC Manager), contractor, and inspector should be familiar with installation details for each BMP used on the project. Details for the installation of all EPSC BMPs shall be included in the Plan. Installation details for BMPs are provided in Chapter 5.

If installed incorrectly, even the best materials will fail, causing more damage and additional expense to the project. For this reason alone, installation procedures should be followed very closely.

Installation of all sediment control measures shall be inspected and any deficiencies corrected prior to the start of land-disturbing activities. Subsequent inspections of any additional installations should also be made throughout the life of the project.

4.8 Operations and Maintenance Guidelines

The selected BMPs shall be operated and maintained consistently with maintenance requirements identified in Schedule A.4 of the NPDES 1200-C General Permit and BMP detail sheets provided in Chapters 5 and 6, and comply with City requirements.

Site-Specific Maintenance and Inspection Instructions

A walk-through or on-site inspection shall be conducted by the EPSC Manager to be certain that all measures have been installed in the field, erosion is being controlled, and transport of sediment into critical areas is being prevented. Deficiencies shall be noted on the EPSC Inspection Form.

Critical inspection points shall be identified to measure performance during storm events. **These critical points include but are not limited to:**

- Outfalls and discharge points
- Slopes that border sensitive areas, such as waterbodies
- Low spots and drainage points at perimeters and at toes of slopes
- Sediment control devices, such as sediment barriers
- Stormdrain inlet protection
- Construction site entrance/exit

These critical areas shall be located on a map and prioritized in the BMP maintenance & inspection schedule.

4.9 Inspection Requirements

The owner/permittee or designated EPSC Manager shall provide ongoing inspections of EPSC BMPs throughout the life of the project.

Minimum inspection requirements are:

- Once per week on active sites.
- Once every two weeks on inactive sites.
- Within 24 hours following a 1/2-inch rain event or greater.
- Each inspection shall be recorded on the EPSC Inspection Form.

The EPSC Inspection Form (Figure 4.9.1) includes the date, inspector's name, weather conditions, observations for all BMP performance, and observations of any discharges and their characteristics (i.e., turbidity, etc.), as required.

Reports shall include information on damages or deficiencies, maintenance or repair activities, and vegetation establishment. Inspection reports must be kept on-site or be maintained by the permittee and made available for agency inspections upon request.

Inspection reports are required for all 1200-C permitted projects. Inspection reports should be kept for a period of three years after completion of final site stabilization and issuance of the notice of termination for the 1200-C NPDES permit by DEQ.

Figure 4.9.1 SAMPLE EROSION CONTROL INSPECTION FORM

PROJECT NAME:		PROJECT #	
LOCATION:		RECEIVING WATER:	
CONTRACTOR:			
EROSION CONTROL FACILITIES			
LOCATION	DESCRIPTION	EFFECTIVENESS	DATE
VISIBLE OR MEASURABLE EROSION LEAVING SITE			
LOCATION	CORRECTIVE & CLEAN-UP MEASURES	EFFECTIVENESS	DATE
COMMENTS AND GENERAL SITE CONDITIONS:			
PREPARED BY:		PERIOD:	
Minimum Inspection Reporting Requirements: Inspect all erosion control facilities a minimum of once per week on active projects. Inspect within 24 hours following a 0.5-inch rain event. Inspect daily during stormy periods or periods of snow melt when runoff occurs daily. Furnish copy to City or DEQ upon request.			

4.10 Erosion Control Contingency Items

During storm events, the contractor shall be prepared to call out maintenance crews to inspect the performance of erosion and sediment control measures. Following storm events, the contractor shall conduct an overall site inspection and replace or repair damaged control measures.

It is a requirement that all construction sites have materials on hand as a contingency in the event of a failure or when required to shore up BMPs installed as part of the Plan. The contingency items may also be used at the discretion of the project inspector to strengthen the erosion prevention measures as needed during construction.

At a minimum, the following materials should be kept on all active project sites for use in emergencies:

- 100 feet of sediment fence or other identified sediment barrier
- 260 square feet of plastic sheeting
- 1,000 feet of rope
- 50 empty sandbags (to be filled as needed)
- 10 bales of straw (used for ground cover)
- 10 biofilter bags with stakes
- 5 catch basin filter inserts

4.11 Minimum Maintenance Requirements

At a minimum, maintenance shall include: (Refer to 4.9 Inspection Requirements during the wet weather season)

- Sweeping tracked sediment from paved areas.
- Weekly inspection of storm drain inlet protection and sediment removal from and around catch basins in the street and on your property.
- Weekly inspection of sediment barriers shall include: removal of accumulated sediment, retrenching bottom of the sediment fence, and general repair of damaged sections.
- Adding rock to construction entrance to maintain effectiveness.
- Limiting construction traffic to construction driveway and paved areas only.
- Immediate repair of BMPs removed or damaged due to or during construction activity.

Ultimately, preventing erosion and controlling sediment on the construction site is the responsibility of the permit holder.

4.12 Sediment Removal/Disposal

Sediment shall be removed from controls such as sediment fences, sediment barriers, check dams, inlet protection, and sediment traps when the sediment buildup has reached one-third the exposed height of the control or storage depth.

Rock filters and filter berm material shall be replaced with new rock material when sediment reduces the filtering capacity by 50 percent. Rock or other material specified shall be added or removed as needed to maintain proper function of the construction entrance areas. All paved areas shall be kept clean (by mechanical means) for the duration of the project.

It is a violation of City Code to release wash water or intentionally wash sediment into the public stormwater system.

In the event of continuous rainfall over a 24-hour period or other circumstances that preclude the operation of equipment where maintenance, sediment removal, or the installation of additional BMPs is necessary, manual labor must be used to ensure site conditions are maintained to ensure water quality protection.

Removed sediment shall be placed in a non-erodible area within the construction site, or removed and disposed of off-site in accordance with all federal, state, and City regulations. Sediment-laden water shall not be flushed into the stormwater system.

4.13 Inspection and Enforcement by the City

4.13.1 Expectations and Penalties

The City of Gresham performs inspections for all construction sites. If any deficiencies are found, the owner/permittee or designated EPSC Manager shall make all corrections requested by the City's inspector (either verbal or written) within the specified timeframe.

Erosion resulting from construction activities must be effectively controlled to keep sediment from leaving the site or the City may limit the amount of disturbed area.

Failure to comply with a written inspection report, verbal direction, or this *Manual* will result in the issuance of a "Notice of Violation." Failure to comply with the notice of violation will result in enforcement action that may include one of the following: a civil citation; administrative fines of not more than \$1,000 per day per item from the date of the initial notice of non-compliance; or termination or suspension of City issued permits (e.g., grading, building). Additionally, sites with 1200-C permits will be referred to DEQ for enforcement action. If previously documented violations are not addressed, the City may utilize the services of an erosion prevention and sediment control contractor to bring the site into compliance and the owner/permittee will be billed for the services.

4.13.2 Criteria for Determining Site Compliance

The City may take enforcement action if any of the following criteria are not met:

- 1) Failure to repair or install BMPs according to the City Inspectors directive (written or verbal) within the specified timeframe.

- 2) Exceedance of the average daily amount of soil loss predicted by the Revised Universal Soil Loss Equation (RUSLE). (See also Appendix B of this manual.) If one pound or more of sediment (wet weight) yield per acre can be collected from a construction site in a single day, the City may require additional BMPs or levels of BMP implementation at the site.
- 3) Violation of State Water Quality Turbidity Rule.
- 4) Failure to respond, contain, or cleanup any other spills or discharges that are capable of polluting stormwater.

Table 4.13.1 Inspection & Maintenance Checklist

This checklist is for use by the EPSC Manager and the City Inspector

Schedule

- ☐ Walk the site during the EPSC Plan development & final process to look for areas of concern, especially sensitive areas.
- ☐ Review schedule to ensure there are no conflicts and that any instream work windows have been accounted for in the overall timeline.
- ☐ Ensure BMPs are installed before earthwork begins.
- ☐ Review project staging schedule to ensure that BMPs are staged accordingly.
- ☐ Ensure that project site has the appropriate and minimum materials on hand to cover each phase of the project. (Refer to Section 4.10).
- ☐ Review inspection schedule frequency to ensure appropriate planning for sensitive areas and the wet weather season.
- ☐ Ensure that seeding will occur by the Sept 1 deadline and that appropriate wet weather BMPs are in place. Review the steps that will be taken to control sediment during earthwork after the seeding deadline.
- ☐ Ensure site is fully stabilized before BMPs are removed.

EPSC Plan

- ☐ Walk the site prior to earthwork to ensure that the Plan is still adequate.
- ☐ Identify where the Plan will be kept on the project site and periodically review to ensure that the Plan is being kept up-to-date.
- ☐ Ensure that a Contingency Plan is in place for unexpected events.
- ☐ Review the steps that will be taken regarding removal and disposal of waste materials (soil, construction debris, etc.), dust control and plans to combat wind erosion with the City Inspector.

Inspection & Maintenance

- ☐ Ensure that catchbasins, stormdrain inlets, sediment barriers and check dams are cleaned when sediment reaches 1/3 the volume or storage depth.
- ☐ Ensure BMPs are repaired and properly functioning and that gravel entrances are periodically maintained. Look for signs of erosion on steep slopes (cut/fill areas) and add BMPs if necessary.
- ☐ Ensure finished slopes or other areas are properly stabilized.
- ☐ Identify areas that will benefit from temporary ground cover/rocking of completed roadways, where additional work will be performed at a later date.
- ☐ Inspect filtration devices for maintenance needs, sand filters, chitosan socks, sediments bags.
- ☐ Inspect sensitive areas that require extra attention such as areas with runoff or runoff, low spots at the toe of the slope, and discharge/outfall locations from the site.
- ☐ Inspect all non-stormwater pollutant control BMPs to ensure proper function.

4.14 Vegetation Establishment Criteria

Because vegetation typically is a primary form of permanent erosion control, it is important to ascertain how quickly and how well the vegetation is becoming established. The Plan shall state the conditions for determining successful vegetation establishment. Vegetation shall be monitored at least monthly to evaluate the following:

- The type of vegetation that is growing (as compared to the type of vegetation that was planted or seeded).
- The density of vegetation that is growing, including the percent of ground that is covered.
- Location and type of erosion (such as sheet erosion, rilling, gully, and localized scour).
- Any instances of unnecessary vegetation removal (root disturbance can greatly increase erosion potential).

Appendix D provides additional information for hydraulic application rates.

Based on regular evaluations of vegetation establishment, recommendations shall be made as to whether the vegetation is establishing well, or whether additional measures must be taken, such as over-seeding, fertilizing, erosion repair, or irrigation. Vegetation monitoring shall continue until the vegetation reaches maturity and is providing the anticipated erosion control effectiveness.

Water quality ponds and swales shall be monitored for vegetation establishment in accordance with the *City of Gresham Water Quality Manual* and the approved Plans to ensure that they are functioning properly.

4.15 Common BMP Installation Mistakes and Maintenance Guidelines

The most frequent causes of BMP failure are lack of preventative practices and poor maintenance of installed BMPs. Erosion prevention and sediment control BMPs must be inspected regularly and operated and maintained using specific procedures to perform properly. Installation mistakes can also impair BMP performance. Inspectors should pay particular attention to BMP maintenance problems and installation mistakes during inspections. Information on BMP installation and maintenance can be found within the BMPs included in Chapters 5 and 6.

4.16 Stabilizing the Site and Terminating the Permit

In order to terminate coverage under the NPDES 1200-C General Permit, the permittee must complete a Notice of Termination (NOT) form and submit it to DEQ. The termination of a 1200-C permit does not relieve the permittee/property owner of other project close-out (final punch list) requirements by the City.

In order for coverage to be terminated, the following conditions must be met:

- a) There is no potential for discharge or a significant amount of construction related sediment to surface waters.
- b) All elements of the EPSCP must be completed.
- c) All temporary erosion and sediment controls as well as construction related materials or wastes must be removed from the site and disposed of properly. This includes any sediment that was being retained by temporary erosion and sediment controls.
- d) All disturbed areas of the site must be stabilized.

Additionally, the City's final inspection punch list items shall be completed. Refer to the *City of Gresham Water Quality Manual* for requirements related to water quality facilities.

Retain permit-related documentation (EPSCP, NOI, City inspection reports, etc.) for a period of one year after the permit is terminated, in accordance with the requirements of the NPDES 1200-C General Permit. Erosion Control Monitoring Forms must be kept for a period of three years after completion of final site stabilization.

Chapter 5 Best Management Practices in Detail

5.1 Overview

This chapter provides detailed descriptions of erosion prevention, runoff control and sediment control BMPs to serve as the foundation of an effective Plan. By selecting various types of BMPs, the designer can ensure a properly protected site. City approved BMPs are organized in this chapter within three functional categories:

- Erosion Prevention
- Runoff Control
- Sediment Control

In addition, thorough Plans incorporate measures to control non-stormwater pollution sources, which are presented in Chapter 6.

Designers and builders must consider the need for each BMP category and select the appropriate mix of BMPs for your project using the following principles:

- Fit the project to the existing topography, soils, and vegetation.
- Minimize disturbance and retain natural vegetation.
- Schedule construction to minimize soil exposure during rainy season.
- Vegetate and mulch denuded areas.
- Minimize concentrated flows and divert runoff away from slopes or critical areas.
- Minimize slope steepness and slope length by using benches, terraces, contour furrows, diversion ditches, or other slope breaks.
- Utilize channel linings and check dams or other temporary structures in drainage channels to slow runoff velocities.
- Keep sediment on site by using sediment basins, traps or sediment barriers.
- Monitor and inspect sites frequently and correct problems promptly.

Critical factors to prevent accelerated erosion:

- ***Minimize the length of time that soils are left exposed.***
 - ***Reduce the total area of exposed soil.***
 - ***Protect critical areas such as drainage channels, streams, and natural watercourses.***
 - ***Stabilize exposed areas quickly.***
 - ***Monitor and maintain EPSC measures.***
-

5.2 Erosion Prevention

This section summarizes a wide range of erosion prevention practices, materials and methods to be applied during earthwork activities including BMPs to prevent erosion on graded surfaces, and biotechnical erosion control methods.

5.2.1 Erosion Prevention (EP) BMPs

Erosion prevention is the highest priority in the overall Plan and should be integrated into a project throughout planning, design, scheduling, and during construction itself. Important erosion prevention concepts related to planning, design, and scheduling are discussed in BMP EP-1. Limiting soil disturbance and establishing vegetative buffers prior to construction are discussed in BMP EP-2. However, this chapter focuses on measures to be implemented during earthwork activities to control erosion.

5.3 Runoff Control

This section identifies BMPs to control stormwater runoff and drainage patterns at construction sites. Runoff control measures must be designed into the Plan and implemented during construction. Runoff control practices are BMPs that are designed to control the peak volumes and flow rates and to prevent scour due to concentrated flows. This chapter identifies approved practices to divert and control runoff.

5.3.1 Runoff Control (RC) BMPs

Even the best erosion control system cannot perform adequately without control of run-on and runoff. It is particularly important to control concentrated flow with measures to prevent rilling and scour of exposed soils. These measures must be in place before the start of the rainy season.

Stormwater runoff leaving the site shall not be sediment laden.

At a construction site, runoff conditions must be evaluated both within the site itself as well as along the site perimeter. Within the site, controls must be installed that will reduce flow velocity and prevent rilling and scour. Along the perimeter, controls should be selected based on consideration of run-on from adjacent areas. Clean run-on should be directed away from construction activities and exposed areas to a stabilized location.

5.4 Sediment Control

This section identifies sediment control measures and methods to prevent sediment from moving offsite. The identified BMPs are to be applied prior to and during earthwork. Sediment control is any practice that traps soil particles after they have been dislodged and moved by wind or water. Sediment control measures are usually passive systems that rely on filtering or settling particles out of the water or wind that is transporting them. Sediment control treats the soil as a waste product that must be removed from where it has been transported and accumulated requiring disposal of at another location. Sediment control measures are considered the “last line of defense” before stormwater runoff leaves the site and not a primary pollution control method, such as source controls (runoff control and erosion prevention).

5.4.1 Sediment Control (SC) BMPs

Continuous inspection and maintenance are critical to the success of sediment control BMPs. Sediment control shall be provided along the downslope site perimeter, at all operational internal and adjacent storm drain inlets, and at vehicle access points prior to ground disturbing activities and at all times during construction.

EPSC Details For Erosion Prevention

SCHEDULING – EP-1

Application: Scheduling involves sequencing construction activities and the installation of erosion prevention and sediment control measures to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff and vehicle tracking. The best way to control the discharge of sediment and related pollutants from a construction site is to prevent erosion from occurring in the first place.

Design Guidelines: The timing of soil-disturbing activities and the timing of implementation of BMPs are both critical to the prevention of accelerated erosion and transport of sediment off-site. The scheduling of grading should take into account the rainy season and shall minimize the length of the time that soils are left exposed, and reduce the total area of exposed soil during the rainy season. Consideration shall be given to phasing the grading and construction so that critical areas (such as highly erodible soils, areas adjacent to receiving waters, etc.) are not disturbed until the non-rainy season, and so the entire area that is disturbed at any one time is kept to a size that can be controlled effectively.

Construction Specifications/Installation:

- The optimum grading period is when the chance for precipitation is minimized (e.g., the non-rainy season), particularly for the critical areas. If precipitation is likely during grading, minimize the length of time that soils are exposed, and the total area of exposure.
- Materials used for erosion and sediment control shall be on site at all times.
- Perform the following actions when precipitation is forecast:
 - Minimize the length of time that the soils are left exposed.
 - Reduce the total area of exposed soil.
 - Protect critical areas such as drainage channels, streams, and natural water courses.
 - Stabilize exposed areas quickly.
 - Ensure inlets are protected and protection measures maintained.
- The schedule shall clearly show how regional precipitation trends relate to soil-disturbing and re-stabilization activities. The construction schedule shall be incorporated into the Erosion Prevention and Sediment Control Plan.
- The schedule shall include detail on the implementation and deployment of temporary soil stabilization measures, temporary sediment controls, tracking controls, wind erosion controls, non-stormwater pollution controls (including waste management and materials pollution controls).
- The schedule shall also include dates for significant long-term operations or activities that may have planned non-stormwater discharges such as dewatering, saw cutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, bridge cleaning, etc.
- Develop the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, pouring foundations, installing utilities, etc., to minimize the active construction area during the rainy season.
- Schedule major grading operations when the chances of precipitation are minimized when practical.
- Schedule the installation, removal, or modification of run-on and run-off controls, and flow conveyance structures, for the non-rainy season or when there is a low probability of precipitation to reduce the likelihood of uncontrolled flow across and from the site.
- Stabilize non-active areas after the cessation of soil-disturbing activities or prior to the onset of precipitation in accordance with local requirements.
- Monitor the weather forecast for rainfall.

- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment controls and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year-round to deploy soil stabilization and sediment control practices. Erosion may be caused during dry seasons by unseasonable rainfall, wind, and vehicle tracking. Keep the site stabilized year-round, and retain and maintain sediment trapping devices in operational condition.
- Sequence trenching activities so that most open portions are closed before new trenching begins.
- Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
- Consider scheduling when establishing permanent vegetation (appropriate planting time for specified vegetation).

Monitoring/Maintenance:

- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule to show updated information on the deployment and implementation of construction site BMPs.

PRESERVATION OF EXISTING VEGETATION / BUFFER STRIPS – EP-2

Application: Maintaining existing vegetation or placing vegetative buffer strips can have numerous benefits for stormwater quality, erosion prevention and sediment control, as well as landscape beautification, dust control, noise reduction, shade and watershed protection.

Design Guidelines: Preservation of existing vegetation and buffer strips shall conform to site conditions, City codes, and permit requirements.

Materials/Equipment: Temporary barrier shall be perimeter fencing or flagging. Fence posts shall either be wood or metal, as appropriate for the intended purpose.

Construction Specifications/Installation:

Timing

- Preservation of existing vegetation shall be provided prior to the commencement of clearing and grubbing operations or other soil-disturbing activities in areas identified on the plans to be preserved, especially on areas designated as environmentally sensitive areas or where no construction activity is planned or will occur at a later date.
- Limits of clearing and grubbing shall be clearly marked prior to any grading or clearing activities.
- Preservation of existing vegetation shall conform to scheduling, City, and permitting agency requirements.

Design and Layout

- Mark areas to be preserved with temporary fencing made of orange polypropylene that is stabilized against ultraviolet light. The temporary fencing shall be at least 3 feet tall and shall have openings not larger than 2 inches x 2 inches.
- The post spacing and depth shall be adequate to completely support the fence in an upright position.
- Minimize the disturbed areas by locating temporary roadways to avoid stands of trees and shrubs and to follow existing contours to reduce cutting and filling.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Construction materials, equipment storage, and parking areas shall be located where they will not cause root compaction.
- Keep equipment away from trees to prevent trunk and root damage at least to drip line.
- Maintain existing irrigation systems.
- Employees and subcontractors shall be instructed to honor protective devices.
- No heavy equipment, vehicular traffic, or storage piles of any construction materials shall be permitted within the drip line of any tree to be retained. Removed trees shall not be felled, pushed, or pulled into any retained trees. Fires shall not be permitted within 100 feet of the drip line of any retained trees. No toxic or construction materials (including paint, acid, nails, gypsum board, chemicals, fuels, and lubricants) shall be stored within 50 feet of the drip line of any retained trees, nor disposed of in any way which would injure vegetation.

Trenching and Tunneling

- Trenching shall be as far away from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching and/or tunneling near or under trees to be retained, tunnels shall be at least 18 inches below the ground surface, and not below the tree center to minimize impact on the roots.
- Tree roots shall not be left exposed to air; they shall be covered with soil as soon as possible, protected, and kept moistened with wet burlap or peat moss until the tunnel and/or trench can be completed.
- The ends of damaged or cut roots shall be cut off smoothly.
- Trenches and tunnels shall be filled as soon as possible or in accordance with local requirements. Careful filling and tamping will eliminate air spaces in the soil which can damage roots.
- After all other work is complete, fences and barriers shall be removed last. This is because protected trees may be destroyed by carelessness during the final cleanup and landscaping.

Vegetative Buffer Strips

- Vegetated buffer strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants (e.g., total and dissolved metals) to settle and partially infiltrate into underlying soils. With proper design and maintenance, filter strips can provide relatively high pollutant removal.
- Designate watercourse buffer-filter strips on the Plan.
- The width of a buffer strip (i.e., flow path length) shall be maximized to the extent feasible, with a 15 feet minimum width. Buffer strips shall be sized in accordance with site conditions, City code, and permit local requirements.

Monitoring/Maintenance:

- Periodically inspect perimeter fencing and flagging and re-establish if damaged or removed.

Common Failures:

- Incorrectly locating vegetation preservation zones on the site.
- New personnel who are unfamiliar with site constraints could accidentally remove vegetation if perimeter controls are not re-established after damage.

SURFACE ROUGHENING – EP-3

Application: Surface roughening involves roughening surface soils by mechanical methods including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting. All slopes prepared by surface roughening must meet engineering compaction requirements required by the project design and City grading requirements. This BMP is intended to only affect surface soils and is not intended to compromise slope stability or overall compaction.

Design Guidelines: While smoothly graded cut and fill slopes may be attractive to the eye, they are not beneficial from the standpoints of erosion prevention and the establishment of vegetative cover. Soil roughening is the creation of a soil surface roughness by mechanical means. Roughening is performed parallel to the slope contours and perpendicular to the direction of runoff. The benefits provided by soil roughening are slowing runoff, enhancing infiltration, moderating soil temperature, trapping moisture, and enhancing seed germination and root penetration. This is particularly important on cut slopes. Where the slope is too steep to allow construction traffic to travel parallel to the slope, cleated dozers traveling up and down the slope can produce a satisfactory texture on newly compacted soil. Table EP-3.1 presents comparative effectiveness of various soil roughening techniques along with erosion rates for smooth slopes without track walking.

Materials/Equipment: Means of soil roughening may include:

- Sheepsfoot rolling
- Track walking
- Scarifying
- Stair stepping
- Imprinting

Construction Specifications/Installation:

Cut Slope Roughening

- Stair-step grade or groove the cut slopes that are steeper than 3H:1V.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet high in soft materials or more than 3 feet high in rocky materials.
- Groove the slope using machinery to create a series of ridges and depressions that run parallel to the slopes contours.

Fill Slope Roughening

- Place on fill slopes with a gradient steeper than 3H:1V in lifts not to exceed 8 inches, and make sure each lift is properly compacted.
- Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches deep.
- Use grooving or tracking to roughen the face of the slopes, if necessary.

- Do not blade or scrape the final slope face.

Roughening for Slopes to Be Mowed

- Slopes which require mowing activities shall not be steeper than 3H:1V.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 inches), and not less than 1 inch deep, and perpendicular to the direction of runoff (i.e., parallel to the slope contours).
- Excessive roughness is undesirable where mowing is planned.

Roughening with Tracked Machinery

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Monitoring/Maintenance:

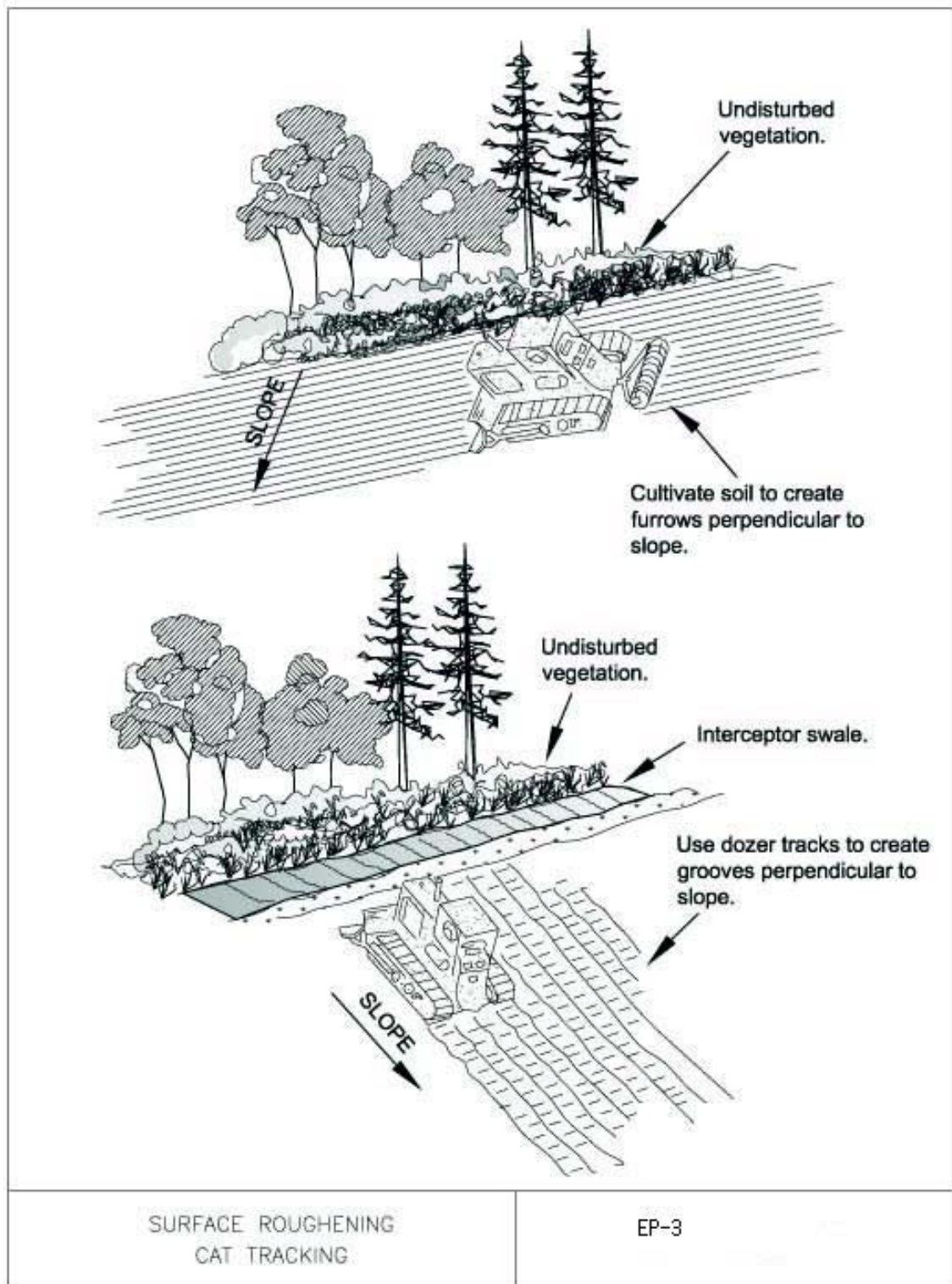
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

TABLE EP-3.1. RESULTS OF RAINFALL SIMULATION TESTING FOR SOIL ROUGHNESS ¹						
Surface Treatment	Measurement	Statistic	Storm Event			Average Increase (+) or Decrease (-) in Roughness
			5-yr	10-yr	50-yr	
Smooth	Normalized Erosion Rate ²	Mean	0.06-0.07	0.09-0.16	0.09-0.12	
		% of Smooth	100%	100%	100%	0%
	Runoff (L)	Mean	256-364	419-470	422-611	
		% of Smooth	100%	100%	100%	0%
Imprinted	Normalized Erosion Rate ²	Mean	0.02-0.03	0.02-0.03	0.02-0.03	
		% of Smooth	26-49%	18-25%	19-22%	76% (-)
	Runoff (L)	Mean	222-416	381-447	464-502	
		% of Smooth	87-114%	91-95%	82-110%	4% (-)
Ripped	Normalized Erosion Rate ²	Mean	0.04-0.07	0.08-0.12	0.06-0.15	
		% of Smooth	66-99%	75-88%	71-121%	12% (-)
	Runoff (L)	Mean	154-276	387-416	374-443	
		% of Smooth	60-76%	89-92%	73-88%	19% (-)
Sheepsfoot	Normalized Erosion Rate ²	Mean	0.03	0.02-0.05	0.04-0.06	
		% of Smooth	46-58%	14-56%	46-51%	55% (-)
	Runoff (L)	Mean	361-375	512-525	503-584	
		% of Smooth	103-141%	109-125%	96-119%	12% (+)
Trackwalked	Normalized	Mean	0.04	0.04-0.05	0.04-0.07	

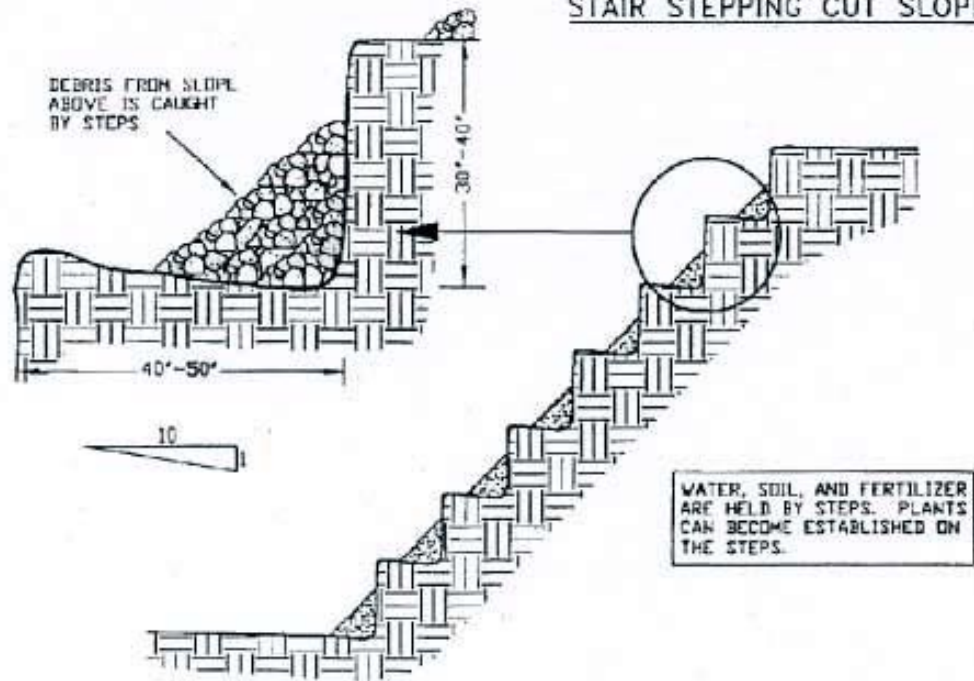
TABLE EP-3.1. RESULTS OF RAINFALL SIMULATION TESTING FOR SOIL ROUGHNESS ¹						
Surface Treatment	Measurement	Statistic	Storm Event			Average Increase (+) or Decrease (-) in Roughness
			5-yr	10-yr	50-yr	
	Erosion Rate ²	% of Smooth	60-80%	30-40%	30-80%	52% (-)
	Runoff (L)	Mean	219-448	461-468	411-580	
% of Smooth		86-123%	100-110%	95-97%	2% (+)	

¹ Erosion Control Pilot Study Report, Caltrans, June 2000, Table 4-1. Testing was conducted at the San Diego State University tilting test bed (fill slope) on a 2:1 (H:V) slope using a clayey sand soil.

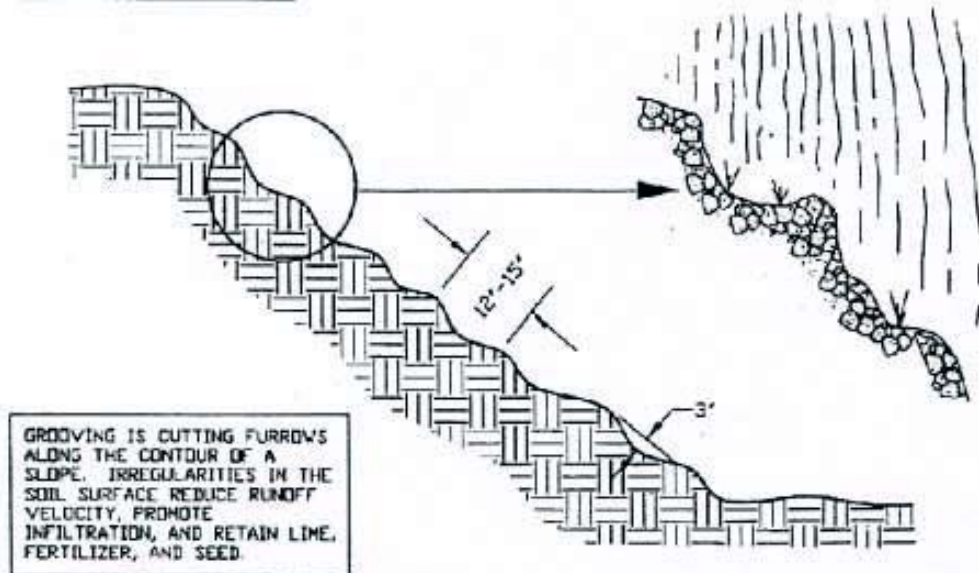
² kg/m2/mm



STAIR STEPPING CUT SLOPES



GROOVING SLOPES



SURFACE ROUGHENING
STAIR STEPPING/GROOVING SLOPES

EP-3

TOPSOILING – EP-4

Application: Topsoiling is the practice of stripping and stockpiling existing topsoil and then spreading it in graded areas to encourage future vegetation growth.

Design Guidelines: Determine whether the quality and quantity of available topsoil justifies selective handling and in consideration of City requirements.

Materials/Equipment: Soils of the textural class of loam, sandy loam, and silt loam are best; sandy clay loam, silty clay loam, clay loam, and loamy sand are fair. Do not use heavy clay and organic soils such as peat or muck as topsoil.

Construction Specifications/Installation:

Stripping and Stockpiling

- Strip topsoil only from those areas that will be disturbed by excavation, filling, or compacting by equipment. A 4- to 6-inch stripping depth is common, but depth varies depending on the site.
- Determine depth of stripping by taking soil cores at several locations within each area to be stripped. Topsoil depth generally varies along a gradient from hilltop to toe of the slope.
- Put sediment basins (SC-9), diversions (RC-3 and RC-4), and other controls into place before stripping.
- Select stockpile location to avoid slopes, natural drainage ways, and traffic routes. On large sites, re-spreading is easier and more economical when topsoil is stockpiled in small piles located near areas where they will be used.
- Use sediment fences (SC-1) or other barriers where necessary to retain sediment.
- Protect topsoil stockpiles by temporarily seeding and/or mulching as soon as possible to assure the stored material is not unnecessarily exposed and allowed to erode. Use locally grown and native seed stocks when possible that are mycorrhizal-dependent.
- Topsoil stockpiles shall be low in height (≤ 3 feet) and flat and be used within 6 months to promote healthy soil organisms and microbes. Stockpiles not used within 6 months shall be reseeded with a species that is mycorrhizal-dependent to avoid the development of anaerobic conditions in the stockpile. In addition, topsoil stockpiles can be turned periodically to keep organisms alive for larger stockpiles and during extremely hot weather.
- For soil stockpile management see BMP EP-22.
- For non-soil stockpile management see BMP NS-9.

Spreading

- Before spreading topsoil, establish erosion and sediment control practices such as diversions, berms (SC-3 and SC-6), dikes, grass-lined channels (RC-5), and sediment basins.
- Where the pH of the existing subsoil is 6.0 or less, or the soil is composed of heavy clays, incorporate agricultural limestone in amounts recommended by soil tests or specified for the seeding mixture to be used. Incorporate lime to a depth of at least 2 inches by disking. Ensure that all of the lime mixture is incorporated into the soil to minimize direct contact with storm water runoff and handle lime in accordance with manufacturing recommendations or BMP NS-7, “Materials Delivery and Storage.”

- Immediately prior to spreading the topsoil, loosen the subgrade by disking or scarifying to a depth of at least 3 inches, to ensure bonding of the topsoil and subsoil. If no amendments have been incorporated, loosen the soil to a depth of at least 6 inches before spreading topsoil.
- Uniformly distribute topsoil to a minimum compacted depth of 2 inches on 3H:1V slopes and 4 inches on flatter slopes.
- Do not spread topsoil while it is frozen or muddy or when the subgrade is wet or frozen.
- Correct any irregularities in the surface that result from topsoiling or other operations to prevent the formation of depressions or water pockets.
- Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compacting, as it increases runoff and inhibits seed germination. Light packing with a roller is recommended where high maintenance turf is to be established.

Monitoring/Maintenance:

- Maintain sediment fences, sediment basins, diversions, and other barriers and controls to retain sediment.
- Prevent erosion of stockpiles.

Common Failures:

- Not loosening subgrade.
- Applying too thin a lift of topsoil.

TEMPORARY SEEDING AND PLANTING – EP-5

Application: Temporary seeding and planting consists of the establishment of temporary vegetative cover on disturbed areas to reduce erosion by seeding with appropriate and rapidly growing annual grasses and forbs.

Design Guidelines: Conditions where practice applies:

- Cleared or graded areas that are exposed and subject to erosion for extended periods.
- Cleared or graded areas exposed to seasonal rains.
- Areas that will not be subjected to heavy wear by construction equipment.
- Temporary seeding is encouraged whenever possible to aid in reducing erosion on construction sites. Temporary seeding is an important component of "phased" construction activities. Permanent seeding shall be applied to areas intended to be left dormant for a year or more.

Recorded shear stress protection of grass-covered surfaces is about 100 times greater than bare soil and about the same as surfaces covered by small riprap. Water velocities withstood by grass mixtures and applications are about 2-3 times higher than bare soil.

Seed Species

- Guidance for seed selection can be obtained from the City of Gresham *Water Quality Manual*. The following criteria shall be considered when selecting seed species for establishing vegetation to stabilize disturbed areas on a construction site:
- Satisfaction of the functional requirements of the design.
- Simplicity of appearance and compatibility with the overall landscape.
- Production of extensive root systems.
- Rapidity of establishment.
- Tolerance of site conditions.
- Resistance to insects and diseases.
- Availability from commercial suppliers.
- Ability to self-perpetuate.
- Compatibility with maintenance objectives.
- Selection of species native to the area wherever practical.
- Do not use forbs in roadside seed mixes where there are deer, to avoid animal hazards.

- Do not use lupine adjacent to agricultural or grazing areas, to avoid causing illness to grazing animals.
- Do not use seed mixes that include noxious weed species.

Materials/Equipment: Choose climatically adapted species that are short-lived, hearty and require low inputs of fertilizer, irrigation and mowing. Use locally occurring species for native grass establishment. Consider seed blends because they are more adaptable.

Use seeds appropriate to the season and site conditions. Use seed rates based on minimum pure live seed (PLS) of 80%. When PLS is below 80% adjust rates accordingly. Consult a local seed supplier, landscape architect, or erosion control specialist for appropriate seed blends.

Construction Specifications/Installation:

Site Considerations

- Prior to seeding, install necessary erosion control practices such as temporary continuous berms (SC-6), diversion dikes (RC-3 and RC-4), grass-lined channels (RC-5), and sediment basins (SC-9).
- Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.
- Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Consider mixes because they are more adaptable than single species.
- Mulch (EP-3) or soil binders (EP-11) shall be used with seeding practices for temporary cover and to aid in the establishment of vegetation.
- Temporary seeding also prevents costly maintenance operations on other erosion control systems. For example, sediment basin maintenance (clean-out) will be reduced if the drainage area has temporary vegetative cover when grading and construction are not taking place. (Temporary seeding is essential to preserve the integrity of earthen structures used to control sediment, such as diversion dikes, and sediment basins.)
- To reduce the amount of fertilizer, pesticides and other inputs needed, choose adapted varieties based on environmental conditions, management level desired, and the intended use. Check with the City prior to use of fertilizer or pesticides.

Timing

- At the onset of inactivity or upon completion of final grading, apply temporary seeding within 7 days during the wet season (October 1st through May 31st) or within 30 days during the dry season (June 1st through September 30th).
- If temporary seeding is applied during the wet season (October 1st through May 31st) additional erosion prevention BMPs shall be implemented until the ground surface is stabilized (e.g., mulch, matting, slope breaks (SC-7)).
- If a healthy stand of grass with at least 80% ground cover is not established by October 1st, other erosion prevention BMPs shall be implemented until the ground surface is stabilized.

- If temporary seeding is applied during the dry season (June 1st through September 30th) or drought periods, irrigate seedbed such that a healthy stand of grass with at least 80% ground cover is established by October 1st.
- The proper time to seed is dependent upon the climate of the area and the species of seed selected. To determine seeding dates for temporary cover, consult the seed supplier.

Seed Mixes

- All seed shall be selected in accordance with City requirements, site conditions, and season.
- Consult a local seed supplier, landscape architect, or erosion control specialist for appropriate seed blends.
- Standard erosion control grass seed mixes are as follows:
 1. **Dwarf Grass Mix (low height, low maintenance)**
Dwarf Perennial Ryegrass, 80 percent by weight
Creeping Red Fescue, 20 percent by weight
 - Application rate: 100 lbs/ac minimum
 2. **Standard Height Grass Mix**
Annual Ryegrass, 40 percent by weight
Turf-Type Fescue, 60 percent by weight
Application rate: 100 lbs/ac minimum
 3. **Sterile Wheat Hybrid**
 - *Triticum aestivum* x *Elytrigia elongata* (Regreen®), 100 percent by weight
 - Application rate: 54 lbs/ac minimum
 - Similar mixes designed to achieve erosion control may be substituted if approved by the City of Gresham.
- The seeding rates are based on a minimum acceptable pure live seed (PLS) of 80%. When PLS is below 80%, adjust rates accordingly.
- Legumes shall be inoculated with the proper rhizobium bacteria before planting. Pellet inoculated seed can be purchased or inoculation can be done in the field. Use only fresh, age-dated inoculate specifically labeled for use with the legume you are using.

Site Preparation

- Grade as needed and feasible to permit the use of equipment for seedbed preparation.
- Install needed erosion control practices, such as sediment basins, diversion dikes and grass-lined channels, prior to seeding. Divert concentrated flows away from seeded areas.

- Soil tests shall be done to determine the nutrient and pH content of soil. Depending on the results of soil tests, soil management may be necessary to adjust the pH to between 6.5 and 7.0 (for most conditions). All lime, fertilizer and other soil amendments shall be added following sound soil management practices.
- Soil amendment: Following a project that exposes subsoils, soils shall be amended to provide suitable conditions for revegetation. Plant life and water absorption capability require similar soil conditions: loose, friable soil with the right balance of organic matter, microorganisms, and minerals. Amendments to consider include topsoil (EP-4), compost, fertilizer, and mycorrhizal fungi and biofertilization (EP-7).

Organic content of amended topsoil shall not exceed 10% for planting beds or 5% for turf areas. Compost in thicker applications (i.e., over 4 inches) provides resistance to weed growth. Organic compost must be certified weed-free.

Commercial fertilizers are labeled to document the ratio of nitrogen (N), phosphorus (P), and potassium (K) (usually listed in order: N-P-K). Fertilizer is applied in various combinations (for example, 20-20-20 or 10-15-5), as determined to be necessary by the results of a soil analysis.

- Surface roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted or hardened the soil shall be loosened with discing, raking or harrowing. Tracking with bulldozer cleats is very effective on sandy soils.
- Hydroseeding and hydraulic planting generally require less seedbed preparation.
- Generally, slopes steeper than 2H:1V that cannot have good seedbed preparations with equipment will require hydraulic planting techniques.
- Seed to soil contact is the key to good germination. Prepare a 3-5 inch deep seedbed, with the top 3-4 inches consisting of topsoil. Note that the earth bed upon which the topsoil is to be placed shall be at the required grade.
- The seedbed shall be firm but not compact. The top 3 inches of soil shall be loose, moist and free of large clods and stones. For most applications, all stones larger than 2 inches diameter, roots, litter and any foreign matter shall be raked and removed. The topsoil surface shall be in reasonably close conformity to the lines, grades and cross sections shown on the grading plans.

Planting

- Seed shall be applied as soon after seedbed preparation as possible, when the soil is loose and moist.
- Always apply seed before mulch, unless seed is applied with a hydraulic matrix or bonded fiber matrix (BFM).
- Apply seed at the rates specified using calibrated spreaders, cyclone seeders, mechanical drills, or hydroseeders so the seed is applied uniformly on the site.
- For hydroseeding, use hydraulic equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the equipment and application method provide a uniform distribution of

the slurry. Place seed (fertilizer, mulch, and tackifier) in the hydroseeder tank no more than 30 minutes prior to application. Perform hydroseeding in a one-step or two-step process.

- Two-step operation (preferred). Step 1 - Apply seed, fertilizer, and tracer (separately or together). Step 2 - Apply mulch and tackifier.
- One-step operation. Apply seed, fertilizer, mulch, tackifier, and tracer in one step. When using the one-step process, double the amount of seed (to compensate for seed suspended above soil by the mulch).

Uniformly apply at the rate specified. Add 500 lbs/ac of hydromulch fiber to the seed and fertilizer mixture to visibly aid uniform application.

- If seed is applied with a bonded fiber matrix, apply BFM from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage, and failure of the BFM.
- Apply fertilizer if required. Fertilizer used within 50 feet of water bodies or wetlands shall be low-phosphorus fertilizer. Seed and fertilizer shall be incorporated into the soil by raking or chain dragging, or otherwise floated, then lightly compacted to provide good seed-soil contact.
- Straw mulch, erosion control blankets (EP-8) or mulch and tackifiers/soil binders (EP-11) shall be applied over the seeded areas.

Monitoring/Maintenance:

- Newly seeded areas need to be inspected frequently to ensure the grass is growing. Areas that fail to establish cover adequate to prevent sheet and rill erosion will be reseeded as soon as such areas are identified. Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.
- If the seeded area is damaged due to concentrated runoff, additional practices may be needed.
- Temporary vegetated areas will be maintained until permanent vegetation or other erosion control practices can be established.

Common Failures:

- Insufficient moisture.
- Weather too hot or too cold.
- Poor seed viability.
- Weed invasion.

PERMANENT SEEDING AND PLANTING – EP-6

Application: Permanent seeding establishes a permanent vegetative cover that will prevent soil detachment by raindrop impact, reduce sheet and rill erosion, and stabilize slopes and channels. Permanent seeding can be used in conjunction with erosion control blankets and mats to provide both temporary and permanent erosion prevention controls. Perennial grasses, when used with turf reinforcement mats, provide a fibrous root network that anchors the channel lining. These treatments can greatly increase the maximum permissible velocities are useful in stabilizing channels and grass-lined channels. Perennial grasses and legumes improve wildlife habitat and improve aesthetics.

The potential for erosion will exist during the establishment stage. Failure to carefully follow sound plant establishment recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.

Specific guidelines for installing sod can be found in EP-21.

Planting of shrubs, trees, and container plants shall be conducted in accordance with specific project landscaping specifications and *City of Gresham Water Quality Manual*.

Design Guidelines: The use of native, indigenous, or naturally-occurring grasses is recommended for biotechnical works. These “native” grasses have evolved in a manner that will not compete with or preclude the establishment, or natural recruitment, of naturally-occurring woody vegetation. Establishment of permanent vegetation provides natural erosion prevention and sediment control by trapping particulates, slowing runoff velocities and enhancing infiltration. Permanent vegetation also is beneficial for long-term aesthetics and wildlife habitat.

Conditions where practice applies:

- Graded, final-graded or cleared areas where permanent vegetative cover is needed to stabilize the soil. Permanent seeding with perennial grasses is recommended when fibrous and deeply rooted are needed to provide slope and soil reinforcement.
- Slopes designated to be treated with erosion control blankets shall be seeded first.
- Grass-lined channels or waterways designed to be treated with turf reinforcement mats, fiber roving systems, or other channel liners require special grass blends.

Seed Species

Guidance for seed selection can be obtained from the *City of Gresham Water Quality Manual*. The following criteria shall be considered when selecting seed species for establishing vegetation to stabilize disturbed areas on a construction site:

- Satisfaction of the functional requirements of the design.
- Simplicity of appearance and compatibility with the overall landscape.
- Production of extensive root systems.

- Rapidity of establishment.
- Tolerance of site conditions.
- Resistance to insects and diseases.
- Availability from commercial suppliers.
- Ability to self-perpetuate.
- Compatibility with maintenance objectives.
- Selection of species native to the area wherever practical.
- Do not use forbs in roadside seed mixes where there are deer, to avoid animal hazards.
- Do not use lupine adjacent to agricultural or grazing areas, to avoid causing illness to grazing animals.
- Do not use seed mixes that include noxious weed species.

Materials/Equipment: Choose climatically adapted perennial species that are long-lived, hearty and require low inputs of fertilizer, irrigation and mowing. Use locally occurring species for native grass establishment. Consider seed blends because they are more adaptable.

Use seeds appropriate to the season and site conditions. Use a seed blend that includes annuals, perennials and legumes. Legumes shall be inoculated with the proper rhizobium bacteria before planting. Pellet inoculated seed can be purchased or inoculation can be done in the field. Use seed rates based on minimum pure live seed (PLS) of 80%. When PLS is below 80% adjust rates accordingly. Consult a local seed supplier, landscape architect, or erosion control specialist for appropriate seed blends.

Construction Specifications/Installation:

Installation

The probability of successful plant establishment can be maximized through good planning, knowledge of soil characteristics, selection of appropriate seed blends for the site, good seedbed preparation, and timely planting. Prior to seeding, install necessary erosion control practices such as diversion dikes (RC-3 and RC-4), grass-lined channels (RC-5), and sediment basins (SC-9). Site area shall be at final grade and not be disturbed by future construction activities.

Timing

- All permanent seeding applications must be completed prior to September 1. If a healthy stand of grass with at least 80% ground cover is not established by October 1st, other erosion prevention BMPs shall be implemented until the ground surface is stabilized.
- If seeding is applied during the dry season (June 1st through September 30th) or drought periods, irrigate seedbed such that a healthy stand of grass with at least 80% ground cover is established by October 1st.

- Apply permanent seeding before the wet season (October 1st through May 31st) or before freezing weather is anticipated.
- Apply permanent seeding on areas left dormant for 1 year or more.
- Apply permanent seeding when no further disturbances are planned.
- To determine optimum seeding schedule, consult a local agronomist, landscape architect, or erosion control specialist.
- Use dormant seeding for late fall or winter seeding schedules in conjunction with other erosion prevention BMPs such as mulches (EP-8), compost blankets (EP-9), soil binders (EP-11), or matting (EP-10).

Seed Mixes

- All seed shall be selected in accordance with City requirements, site conditions, and season.
- Consult a local seed supplier, landscape architect, or erosion control specialist for appropriate seed blends.
- Use only native species within 150 feet of streams and wetlands.
- Use a seed blend that includes annuals, perennials, and legumes.
- Use seed rates based on pure live seed (PLS) of 80%. When PLS is below 80%, adjust rates accordingly.

Site Preparation

- Bring the planting area to final grade and install the necessary erosion control BMPs (e.g., sediment basins and temporary diversion dikes).
- Divert concentrated flows away from the seeded area.
- Conduct soil test to determine pH and nutrient content. Roughen the soil by harrowing, tracking, grooving or furrowing.
- Apply amendments as needed to adjust pH to 6.0-7.5. Incorporate these amendments into the soil. Prepare a 3-5 inch deep seedbed, with the top 3-4 inches consisting of topsoil. The seedbed shall be firm but not compact. The top 3 inches of soil shall be loose, moist and free of large clods and stones. The topsoil surface shall be in reasonably close conformity to the lines, grades and cross sections shown on the grading plans.
- Soil amendment: Following a project that exposes subsoils, soils shall be amended to provide suitable conditions for revegetation. Plant life and water absorption capability require similar soil conditions: loose, friable soil with the right balance of organic matter, microorganisms, and minerals. Amendments to consider include topsoil (EP-4), compost, fertilizer, and mycorrhizal fungi and biofertilization (EP-7).

- Organic content of amended topsoil shall not exceed 10% for planting beds or 5% for turf areas. Compost in thicker applications (i.e., over 4 inches) provides resistance to weed growth. Organic compost must be certified weed-free.
- Commercial fertilizers are labeled to document the ratio of nitrogen (N), phosphorus (P), and potassium (K) (usually listed in order: N-P-K). Fertilizer is applied in various combinations (for example, 20-20-20 or 10-15-5), as determined to be necessary by the results of a soil analysis.

Planting

- Seed to soil contact is the key to good germination.
- Seed shall be applied immediately after seedbed preparation while the soil is loose and moist. If the seedbed has been idle long enough for the soil to become compact, the topsoil shall be harrowed with a disk, spring tooth drag, spike tooth drag, or other equipment designed to condition the soil for seeding.
- Harrowing, tracking or furrowing shall be done horizontally across the face of the slope.
- Always apply seed before applying mulch, unless using a hydraulic matrix or bonded fiber matrix where seed is mixed with mulch prior before application.
- Apply seed at the rates specified using calibrated seed spreaders, cyclone seeders, mechanical drills, or a hydroseeder so the seed is applied uniformly on the site.
- Broadcast seed shall be incorporated into the soil by raking or chain dragging, and then lightly compacted to provide good seed-soil contact.
- For hydroseeding, use hydraulic equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the equipment and application methods provide a uniform distribution of the slurry. Place seed (fertilizer, mulch, and tackifier) in the hydroseeder tank no more than 30 minutes prior to application. Perform hydroseeding in a one-step or two-step process.
- Two-step operation (preferred). Step 1 - Apply seed, fertilizer, and tracer (separately or together). Step 2 - Apply mulch and tackifier.
- One-step operation. Apply seed, fertilizer, mulch, tackifier, and tracer in one step. When using the one-step process, double the amount of seed (to compensate for seed suspended above soil by the mulch).
- Uniformly apply at the rate specified. Add 500 lbs/acre of hydromulch fiber to the seed and fertilizer mixture to visibly aid uniform application.
- Apply fertilizer as specified and allowed by City. Fertilizer used within 50 feet of water bodies or wetlands shall be low-phosphorus fertilizer. For an alternative to fertilizers, see Mycorrhizae and Biofertilizers (EP-7).
- Apply mulch, compost blankets, or matting as specified, over the seeded areas.

Monitoring/Maintenance:

- Newly seeded areas need to be inspected frequently to ensure the grass is growing.
- If the seeded area is damaged due to runoff, additional stormwater measures shall be applied.
- Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.
- Irrigation/watering shall be used as necessary to maintain healthy vegetation.

Common Failures:

- Insufficient moisture.
- Weather too hot or too cold.
- Poor seed viability.
- Weed invasion.
- Competition from temporary seeding.

MYCORRHIZAE AND BIOFERTILIZERS – EP-7

Application: Mycorrhizae and biofertilizers are very important to any revegetation effort, as they help to rebuild the living soil that can get damaged by any earthwork. Most desirable species will have a very difficult time out competing weeds without mycorrhizae, or the slowly released nutrients provided by biofertilizers.

Mycorrhizal Fungi. Mycorrhizal fungi form a bridge between the roots and the soil, gathering nutrients from the soil and giving them to the roots. There are two major types of mycorrhizae: ectomycorrhizal fungi (EM) and endomycorrhizal (arbuscular) fungi (AM). While both types penetrate the plant roots, ectomycorrhizae spread their hyphae between root cells, while endomycorrhizae hyphae penetrate root cells. Ectomycorrhizae hosts include members of the *Pinaceae* (Pine family) and *Fagaceae* (Oak and Beech family), as well as few others in scattered families, and involves a “higher” (often mushroom-forming) fungus. EM-dominated forests tend to be low in species diversity compared to arbuscular (AM) forests, and have a thick layer of organic debris on the forest floor.

Endomycorrhizae are the most common, and are found in grasses, shrubs, trees including redwood and cedar, most domestic plant species and many other members of the forest understory. EM fungi are usually specific to a certain host species, but most species of endomycorrhizae will form relationships with almost any AM host plant, and is therefore much easier to specify. There are four major plant families that usually do not form mycorrhizae: *Amaranthaceae* (Pigweed family), *Brassicaceae* (Mustard family), *Chenopodiaceae* (Goosefoot family), and *Zygophyllaceae* (Caltrop family). These plant families are well known as weeds. Therefore, if you do not ensure an adequate supply of mycorrhizae, you may inadvertently inhibit growth of desirable species and allow for rapid growth of undesirable species.

Biofertilizers. Biofertilizers are fertilizers containing living microorganisms, which increase microbial activity in the soil. Often, organic food is included to help the microbes get established.

Soils need nitrogen, phosphorus, and potassium in order to produce healthy plants. Biofertilizers are alternatives to chemical fertilizers (N-P-K). Applying biofertilizers, which are readily available from a variety of soil conditioner manufacturers, increases microbial activity in soil. With biofertilizers, soil fertility is increased by bacteria that fix nitrogen from the air into chemicals that aid plant growth, such as nitrate or ammonia. Microbes can also improve the structure of the soil through secretions that make the soil particles stick together, forming larger particles and thus increasing soil porosity. Microbes also benefit plants by providing a natural defense against soil-borne diseases or pathogens.

Although chemical fertilizers have their benefits, there are certain characteristics offered by biofertilizers that the typical N-P-K fertilizers cannot match. Therefore, the chemical approach may be economical in the short term, but biofertilizers may be less expensive in the long term.

Important functions of soil microbes:

- Convert ambient nitrogen into forms that the plants can use (nitrate and ammonia).
- Increase soil porosity by gluing soil particles together.
- Defend plants against pathogens by out-competing pathogens for food.
- Saprophytic fungi in the soil break leaf litter down into usable nutrients.

The high soil porosity (large spaces between soil particles) caused by microbes is important because it aids water infiltration. If pore spaces are too small, they cannot break the surface tension of a water droplet, and water will run off, instead of saturating the soil, where it can be taken up by plant roots.

The best approach may be to combine both chemical fertilizers and biofertility. A combination of chemical fertilizers and biofertilizers gives the plants a jump-start and maintains them until the microbes can get established.

Design Guidelines: Relationships between mycorrhizal fungi and biofertilizers:

Plant roots secrete food for bacteria and fungi, which attracts nematodes (worms) to the roots. Nematodes eat bacteria and fungi, and excrete nitrogen, sulphur and phosphorus in a form that the plants can use. The nematodes only keep 1/6 of the nitrogen that they process—5/6 is excreted to the plant. Once the nematodes have excreted the nutrients, the hyphae of the mycorrhizal fungi pick them up and transfer them into the plant. Bacteria are the most nitrogen-rich organisms on earth, and bacteria and fungi are the least-leachable forms of nitrogen because of these symbiotic relationships.

However, AM hyphae pick up more nutrients than just those excreted by nematodes. One of the most beneficial properties of AM mycorrhizae is its ability to “mine” the soil great distances from the roots for nutrients, especially those, such as phosphorus, that are poorly mobile in the soil. AM mycorrhizae also assist in picking up water further away from the roots, and block pest access to roots.

Mycorrhizae also benefit plants indirectly by enhancing the structure of the soil. AM hyphae excrete gluey, sugar-based compounds called Glomalin, which help to bind soil particles, and make stable soil aggregates. This gives the soil structure, and improves air and water infiltration, as well as enhancing carbon and nutrient storage.

Most natural, undisturbed soils have an adequate supply of mycorrhizae for plant benefits; however, the following practices can reduce mycorrhizae populations to inadequate levels:

- Erosion
- Grading
- Excavation
- Occupation with non-mycorrhizal plants (weeds)
- Loss of original topsoil

The best way to be sure that appropriate mycorrhizal levels exist in soil onsite is to get a soil sample analyzed for mycorrhizal presence. To maintain healthy mycorrhizae populations:

- Do not apply too much phosphorus, as high levels will limit mycorrhizal effectiveness, low to moderate levels, or slow-release phosphorus will maximize plant benefits.
- Limit fungicide use, as some fungicides damage AM fungi.
- Limit soil disturbance, as disruption of the hyphae in the soil limits water and nutrient movement into the root.
- Consult a landscape architect or agronomist for soil sampling guidance, laboratory selection, and product selection as necessary.

Materials/Equipment: See section entitled, “Application.”

Construction Specifications/Installation:

Endomycorrhizae shall be applied at a rate of 3,600,000 propagules per acre, which equates to 60 lbs per acre or 1.4 lbs/1000 ft². Mycorrhizae is most frequently applied via hand seeding, seed drilling, hydroseeding, broadcast and till, planting, or as a nursery medium. If installing container plants, packets of mycorrhizae may be planted along with the plant, at a rate of 1 packet per foot of plant height or container width.

Apply biofertilizer based on soil test results, or at the rate recommended by the manufacturer.

Monitoring/Maintenance:

No maintenance should be necessary, although if plants do not appear to be growing vigorously, analysis of mycorrhizal density in the soil can help to determine if you need to apply more.

MULCHES – EP-8

Application: Mulching is the process of applying bulk materials to the soil surface to reduce rainfall impact, increase infiltration and, in some cases, aid in revegetation. Common types of mulch include vegetable fibers, green material, hydraulic mulches from recycled paper or wood fibers, hydraulic matrices (EP-11), straw mulch, and compost blankets (EP-9). Their use and relative longevity is variable. Mulches may include a tackifier to increase the longevity of the application. Mulches function by:

- Moderating soil temperature.
- Reducing soil moisture loss through evaporation.
- Protecting the soil surface from compaction and increasing infiltration.
- Reducing weed competition for desirable plants.
- Armoring the soil against rain drop impact and sheet erosion from runoff.

Design Guidelines: Some typical uses for mulches are:

- As a non-vegetated cover on disturbed sites to temporarily prevent erosion until permanent vegetation can be established.
- In conjunction with seed and soil amendments to establish temporary or permanent vegetative cover.
- To add organic matter, fertility, and improve structure of poor soils.
- As a long-term, non-vegetative ground cover, usually around existing plants, such as trees or shrubs.

Materials/Equipment: See Table EP-8.1 for comparative selection criteria. Some common types of organic mulch are:

- Plant fibers (i.e., straw).
- Composted organic materials/green material (EP-9).
- Hydraulic mulches made from wood fiber or recycled paper (EP-11).
- Erosion control blankets and mats (EP-10).
- Hydraulic matrices (combinations of fibers and adhesives) (EP-9).
- Onsite wood grindings and chipping will only be considered on a site-by-site basis. Generally, grindings will only be considered for slopes less than 5% and on slopes not to receive permanent vegetation.

Plant Fiber Mulches: Plant fibers such as straw mulch must be anchored in place either by punching or crimping them into the soil surface, or by holding them in place with a hydraulically-applied adhesive. The standard application rate for this practice is 2 tons/acre (4,000 lbs/acre) of the straw so that 80-90% of the ground is covered.

Composted Organic Materials/Green Material: Composted organic materials or green materials act as mulches, but have a primary function as soil amendments.

Hydraulic Mulches: Hydraulic mulches and hydraulic matrices are applied using standard hydraulic seeding equipment. The equipment usually consists of a large water tank with some form of agitator which enables the operator to mix seed, soil amendments, and mulch in the tank, and a pump. The pump pushes the resulting slurry through a hose or cannon mounted on top of the machine for application on the soil surface.

When using hydraulic techniques there are requirements for successful vegetation establishment:

- Selection of proper seed mixture adapted to the climate that meets project and City requirements.
- Proper usage of soil amendments and/or biostimulants (EP-7) to enhance soil fertility.

TABLE EP-8.1. COMPARATIVE SELECTION CRITERIA—MULCHING BMPs

Surface Mulch Category	Unit Cost Installed	Estimated Relative Erosion Control Effectiveness	Standard Application Rate	Ease of Installation	Longevity/Degradability
Hydraulic Mulching Types: Wood, paper, cellulose fiber	\$900–1,200/ac	50 – 60%	2,000 lbs/ac	2	6 mo
Compost Application	\$900–1,200/ac	40 – 50%	(1 inch blanket application)	3	6 mo
	\$7,000-10,000/ac	95 - 99%	(2 inch blanket application)	3	12 mo
	\$10,000-15,000/ac	95 - 99%	(3 inch blanket application)	3	12-18 mo
Straw Mulching Types: Rice and wheat	\$1,800–2,100/ac	90 – 95%	2 tons/ac	3	6 mo
Wood Chip Types: Blanket	\$900–1,200/ac	Unknown		3	24 mo
Hydraulic Matrices Types: Wood mulch + Granular or liquid binder Paper mulch + Granular or liquid binder Cellulose mulch + binder	\$1,000-2,000/ac	65 - 99%	2,000 lbs/ac mulch + 10% tackifier		
				2	6-12 mo
				2	3-6 mo
				2	3-6 mo
Bonded Fiber Matrices	\$5,000–6,500/ac	90 – 99%	3,500 – 4,000 lbs/ac	3	6-12 mo
Erosion Control Blankets and Mats					
Types:					
Biodegradable					
Jute	\$6,000–7,000/ac	65 – 70%	N/A	4	12-18 mo
Curled Wood Fiber	\$8,000–10,500/ac	90 – 99%	N/A	4	12 mo
Straw	\$8,000–10,500/ac	90 – 99%	N/A	4	12 mo
Wood Fiber	\$8,000–10,500/ac	90 – 99%	N/A	4	6-12 mo
Coconut Fiber	\$13,000–14,000/ac	90 – 99%	N/A	4	24-36 mo
Coconut Fiber Net	\$30,000–33,000/ac	90 – 99%	N/A	4	24-36 mo

Straw Coconut	\$10,000–12,000/ac	90 – 99%	N/A	4	18-24 mo
Non-Biodegradable					
Plastic Netting	\$2,000–2,200/ac	< 50%	N/A	4	24 mo
Plastic Mesh	\$3,000–3,500/ac	75 – 80%	N/A	4	24 mo
Synthetic Fiber w/Netting	\$34,000–40,000/ac	90 – 99%	N/A	4	permanent
Bonded Synthetic Fibers	\$45,000–55,000/ac	90 – 99%	N/A	5	permanent
Combination Synthetic and Biodegradable Fibers	\$30,000–36,000/ac	85 – 99%	N/A	5	variable
Criteria Definition					
Unit Cost Installed:	Cost of materials and labor to effect installation on a per acre basis				
Relative Erosion Control:	Reduction in soil loss when mulch is compared to bare soil (control) under similar conditions of soil, slope length and steepness and rainfall simulation				
Ease of Installation:	Ratings range from 1 (relatively easy or few steps required for application/installation) to 5 (labor intensive or numerous steps required for application/installation)				
Longevity/Degradability:	Functional longevity in terms of erosion control effectiveness				
Source: Erosion Control Pilot Study Report, Caltrans, June 2000, and Soil Stabilization for Temporary Slopes, Caltrans 1999. Adapted and Updated January 2005					

- Conduct work when there is adequate moisture in the ground to support plant germination and growth, preferably before the wet season, or provide supplemental irrigation. (Note: In Gresham, compost tends to furnish its own moisture sufficient for seed germination.)
- Apply seed, fertilizer, and mulch in a two-step process, with seed and fertilizer applied in the first step, and the mulch applied over the seed in a second step (see Planting under EP-5 or EP-6).
- Use mulches with some form of tackifying agent to hold them on the soil.
- Re-apply as necessary due to weathering—be prepared to budget for two seasons of inspection and maintenance.

Bonded Fiber Matrices: Bonded Fiber Matrices (BFMs) are hydraulically-applied, erosion prevention systems composed of long strand mulch fibers joined together by high-strength adhesives, creating a continuous, three-dimensional blanket that adheres to the soil surface. The system is applied to the soil as a viscous mixture, and when it dries (depending on the product, BFMs require 12-24 hours to dry to become effective), creates a high-strength, porous and erosion-resistant mat.

BFMs are typically applied at rates from 1.5 to 2 tons/acre based on the manufacturer's recommendation.

Some characteristics of bonded fiber matrices are:

- They can be applied using standard hydraulic seeding equipment.
- All components—fiber and adhesives—are mixed together in one bag.
- The binder systems do not dissolve or disperse upon rewetting.
- The dried matrix is porous, allowing water to penetrate into the soil.
- They can be applied with or without seed and do not inhibit plant growth.

Construction Specifications/Installation:

- Mulch shall be used for temporary applications only; permanent erosion control measures shall also be applied.

- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical.
- Avoid mulch over-spray onto the traffic areas, sidewalks, lined drainage channels, and existing vegetation.
- Divert concentrated flows around mulched areas (RC-1, RC-3, RC-4, and RC-5).

Wood Fiber Mulch

- Wood fiber mulch is a component of hydraulic applications. It shall be used in combination with seed and fertilizer. It is typically applied at the rate of 2,000-4,000 lb/acre with 0-5% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer) and applied as a slurry. This type of mulch is manufactured from wood or wood waste from lumber mills or from urban sources.
- Wood fiber mulch can be specified with or without a tackifier; previous work has shown that wood fiber mulches with tackifiers have better erosion control performances.
- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Oregon DOT Standard Specifications.

Recycled Paper Mulch

- Recycled paper mulch contains fibers of shorter length than wood fiber mulches and is typically made from recycled newsprint, magazine, or other waste paper sources. It is a component of hydraulic applications and shall be used in combination with seed and fertilizer. It is typically applied at the rate of 1-2 tons/acre. It can be specified with or without a tackifier.

Green Material

- This type of mulch is produced by recycling vegetation trimmings such as grass, shredded shrubs and trees. Methods of application are generally by hand, although pneumatic methods are available. Mulch shall be composted to kill weed seeds.
- It may be used as a temporary ground cover with or without seeding.
- The green material shall be evenly distributed on site to a depth of not more than 2 inches.

Hydraulic Matrix

- Hydraulic matrix is a combination of wood fiber mulch and a tackifier applied as a slurry. It is typically applied at the rate of 2,000-4,000 lb/acre with 5-10% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer).
- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Oregon DOT Standard Specifications.
- Hydraulic matrices require 24 hours to dry before rainfall occurs to be effective unless approved by the City inspector.

Bonded Fiber Matrix

- Bonded fiber matrix (BFM) is a hydraulically-applied system of fibers and adhesives that upon drying forms an erosion-resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,000 to 4,000 lb/acre based on the manufacturer's recommendation. The biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM shall also be biodegradable and shall not dissolve or disperse upon re-wetting. Biodegradable BFMs shall not be applied immediately before, during, or immediately after rainfall if the soil is saturated. Depending on the product, BFMs require 12-24 hours to dry to become effective.

- Bonded fiber matrices shall be applied from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage, and failure of the BFM.

Straw Mulch

- All materials shall conform to Oregon DOT Standard Specifications.
- Straw shall be derived from wheat, rice, or barley. The straw mulch contractor shall furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before straw obtained from outside the county is delivered to the site of the work. Straw that has been used for stable bedding shall not be used.
- Apply loose straw at a minimum rate of 4,000 lb/acre, or as indicated in the project EPSC Plan, either by machine or by hand distribution.
- The straw mulch must be evenly distributed on the soil surface.
- Avoid placing straw onto the traffic areas, sidewalks, lined drainage channels, walls, and existing vegetation.
- Anchor the mulch in place by using a tackifier (preferred) or by punching or crimping it into the soil by mechanical incorporation.
- If using a tackifier to anchor the straw mulch in lieu of incorporation, roughen embankment or fill areas by rolling with a crimping or punching-type roller or by track walking before placing the straw mulch. Track walking shall only be used where rolling is impractical.
- A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place (see Oregon DOT Standard Specifications).
- A tackifier is typically applied at a rate of 125 lb/acre. In windy conditions, the rate is typically 178 lb/acre.
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions and longevity. If the selected method is mechanical incorporation of straw mulch into the soil, then it shall be applied as follows:
 - Applying and incorporating straw shall follow the requirements in Oregon DOT Standard Specifications.
 - On small areas, a spade or shovel may be used.
 - On slopes with soils, which are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw may be punched into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a “crimper.”
 - On small areas and/or steep slopes, straw may also be held in place using plastic netting or jute. The netting shall be held in place using 11 gage wire staples, geotextile pins, or wooden stakes. Refer to Erosion Control Blankets and Mats (EP-10).

Monitoring/Maintenance:

- Maintain a continuous, temporary mulched ground cover throughout the period of construction when the disturbed soils are not being reworked or in areas that are non-active.
- Inspect before expected rain events. Repair any damaged ground cover and re-mulch exposed areas.
- The key consideration in maintenance and inspection is that the mulch needs to last long enough to achieve erosion control objectives. Mulch is a temporary ground cover and not suitable for long-term erosion control.

- Reapplication of mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.
- After any rainfall event, slopes shall be inspected and maintained to reduce or prevent erosion.

Common Failures:

- Areas where healthy vegetation cover failed to establish.
- Drainage-related failures, such as concentrated runoff.

COMPOST BLANKETS – EP-9

Application: A compost blanket is a layer of compost designed to prevent erosion, especially rills and gullies that may form under more traditional methods of erosion control. In many cases, a compost blanket can be more effective at vegetation establishment, weed suppression, and erosion control than an erosion control blanket (ECB) because it comes in better contact with the underlying soil, reducing the chance of rill formation. Compost blankets can be applied by hand, conveyor system or compost spreader; however, the most cost-effective and efficient method is the use of a pneumatic delivery system, i.e. a compost blower truck.

A compost blanket is used on slopes to prevent erosion from rain impact and, in some cases, to increase infiltration rates. Compost blankets can increase infiltration rates and decrease sediment delivery by 99% compared to bare soil. Compost binds heavy metals and can break hydrocarbons down into carbon, salts and other harmless compounds. Run-off from compost treated sites has very low soluble salts, and all metals and nutrients are well within pollution leaching limits. Compost is organic, biodegradable, renewable, and can be left onsite—particularly important near streams

Design Guidelines: Testing has shown that compost blankets are effective on up to a 2H:1V slope. For steeper slopes, there are products designed to enhance adhesion of the compost to the slope, but the effectiveness of such products are unknown. Adding components such as a tackifier, or using compost blankets in conjunction with other techniques such as compost berms as slope interrupters can increase the allowable steepness of the slope to be treated. However, slopes of this steepness would likely require customized stabilization techniques recommended by an engineer.

Materials/Equipment: There are many types of compost, all with different properties. Compost can be derived from feedstocks, biosolids, leaf and yard trimmings, manure, wood, or mixed solid waste, and must be treated with heat to remove pathogens and destroy noxious weeds. The most important criteria for quality compost are the "cooking" temperature and the duration of composting.

All types of vegetation have different nutrient or moisture needs; therefore, a compost sample shall be inspected by a qualified individual and compost specifications modified as necessary. For compost blankets, compost shall have the specifications presented in Table EP-9.1 (after AASHTO).

Compost that is too dry is harder to apply, while that which is too wet is heavier and harder to transport. In Gresham, use compost with slightly drier moisture content because it will absorb water. The percentage of carbon based materials in finished compost shall range between 40-70%—compost with higher percentages of organic matter is preferred.

Compost must be weed and pesticide free, with manmade materials comprising less than 1%. Compost blankets can be applied in a variety of ways; however, the most efficient and cost-effective way is through the use of a pneumatic blower truck.

Construction Specifications/Installation:

- Prepare the slopes by removing loose rocks, roots, clods, stumps and debris over 2 inches in diameter.
- Track-walk slopes if feasible before application.
- For very steep slopes (2H:1V to 1V:1V), compost berms can be installed along the contour at intervals over the compost blanket in much a similar manner as fiber rolls and tackifier applied to improve effectiveness.
- Compost blankets shall be extended 3-6 feet over the top shoulder of the slope to prevent water from flowing underneath.

- Compost blankets shall not be applied in areas of concentrated flow, and can be used in conjunction with compost berms or socks.
- Blankets are applied in thicknesses of 1/2 inch to 4 inches, depending upon the intended purpose. As a general rule, the more precipitation, the thicker the required compost blanket. For maximum unvegetated erosion control, use thicker blankets. For unvegetated applications (without seed), the compost blanket shall range from 2 to 4 inches thick. For vegetated applications (with seed), the compost blanket shall range from 1.5 to 2 inches thick.

Monitoring/Maintenance: Inspect blankets after each rain event. Re-apply blanket material if needed. Blankets can be hydroseeded if vegetation fails to establish.

Common Failures:

- The success of compost blankets is dependent upon the blanket not being undermined by water; this can be accomplished by keying in the top of the blanket, or the use of a compost berm or sock at the top of the slope.
- Another frequent cause of failure is poor maintenance.

TABLE EP-9.1. COMPOST SPECIFICATIONS

Parameters ^{1,4}	Reported as (Units of Measure)	Surface Mulch to be Vegetated	Surface Mulch to be left Unvegetated
pH ²	pH units	5.0-8.5	N/A
Soluble Salt Concentration ² (electrical conductivity)	dS/m	Maximum 5	Maximum 5
Moisture Content	%, wet weight basis	30-60	30-60
Organic Matter Content	%, wet weight basis	25-65	25-100
Particle Size	% passing a selected mesh size, dry weight basis	3", 100% passing 1", 90% to 100% passing ¾", 65%-100% passing ½", 0%-75% passing Max. particle length = 6	3", 100% passing 1", 90% to 100% passing ¾", 65%-100% passing ½", 0%-75% passing Max. particle length = 6
Stability ³ Carbon Dioxide Evolution Rate	Mg CO ² -C per g OM per day	<8	N/A
Physical Contaminants (man-made inerts)	%, dry weight basis	<1	<1

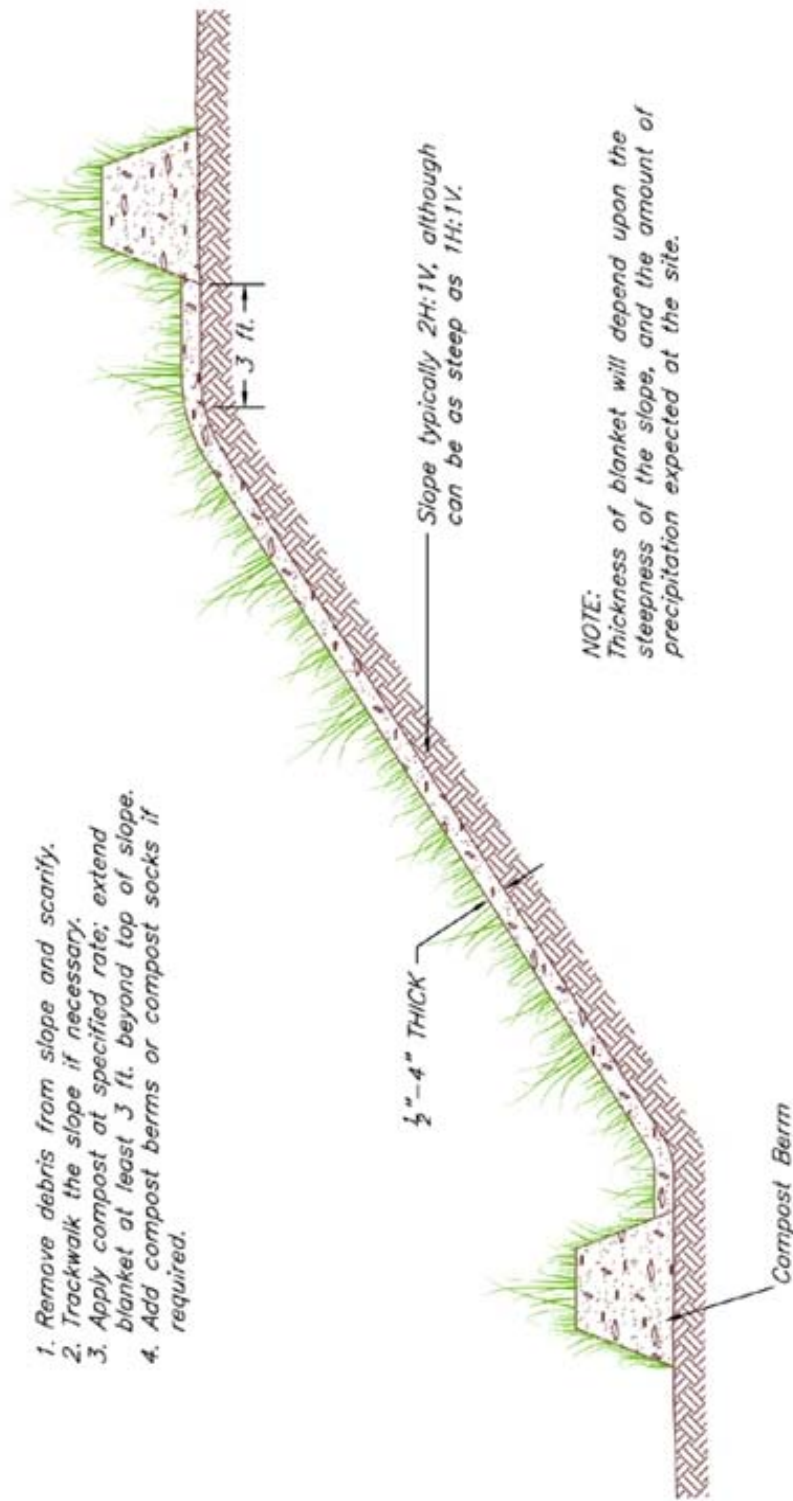
¹ Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, the US Composting Council).

² Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to the compost in use.

³ Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.

⁴ Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

1. Remove debris from slope and scarify.
2. Trackwalk the slope if necessary.
3. Apply compost at specified rate; extend blanket at least 3 ft. beyond top of slope.
4. Add compost berms or compost socks if required.



NOTE:
Thickness of blanket will depend upon the steepness of the slope, and the amount of precipitation expected at the site.

COMPOST BLANKETS

FILE: CBLNKT

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EROSION CONTROL BLANKETS AND MATS – EP-10

Application: Erosion control blankets and mats (also known as rolled erosion control products—RECPs) are rolled, blanket-like materials used to provide erosion control by protecting the bare soil from rainfall impact, increasing infiltration, and promoting vegetation by protecting seeds from predators and moderating soil temperature. This class of products includes manufactured mulch materials that are produced in a roll configuration that is placed on the ground and held in place by stakes, metal staples, geotextile pins or other fastening systems. The mulch within the blanket can be held in place by netting, sewing, adhesives or a combination of these methods. Erosion control blankets and mats can be biodegradable or synthetic and can be temporary or permanent erosion control applications.

Design Guidelines: Always follow the manufacturer's recommendation on staple types, patterns and the number to use per square yard.

Materials/Equipment:

Erosion control blankets are grouped into three types: biodegradable, non-biodegradable, and a combination of synthetic and biodegradable.

Biodegradable Blankets and Mats

In order for blankets to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable. Biodegradable blankets and mats are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials.

- **Jute Mesh:** Jute is a natural fiber that is made into a yarn which is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations. This mat is not to be used as a sole treatment for groundcover within the City.
- **Curled Wood Fiber:** Excelsior (curled wood fiber) blanket material shall consist of machine produced mats of curled wood excelsior with 80% of the fiber 6 inches or longer. The excelsior blanket shall be of consistent thickness. The wood fiber shall be evenly distributed over the entire area of the blanket. The top surface of the blanket shall be covered with a photodegradable extruded plastic mesh. The blanket shall be smolder resistant without the use of chemical additives and shall be non-toxic and non-injurious to plant and animal life. Excelsior blanket shall be furnished in rolled strips, a minimum of 4 feet wide, and shall have an average weight of 0.1 lb/ft², $\pm 10\%$, at the time of manufacture. Excelsior blankets shall be secured in place with wire staples. Staples shall be made of 0.12-inch steel wire and shall be U-shaped with 8-inch legs and a 2-inch crown. Always follow the manufacturer's recommendation on staple types, patterns and the number to use per square yard or meter.
- **Straw:** Straw blankets shall be machine-produced mats of straw with a lightweight biodegradable netting top layer. The straw shall be attached to the netting with biodegradable thread or glue strips. The straw blanket shall be of consistent thickness. The straw shall be evenly distributed over the entire area of the blanket. Straw blanket shall be furnished in rolled strips a minimum of 6.5 feet wide, a minimum of 80 feet long and a minimum of 0.05 lbs/ft². Straw blankets shall be secured in place with wire staples. Staples shall be made of 0.12-inch steel wire and shall be U-shaped with 8-inch legs and a 2-inch crown.
- **Wood Fiber:** Wood fiber blankets are comprised of biodegradable fiber mulches with extruded plastic netting held together with adhesives. The material is designed to enhance revegetation. The material is furnished in rolled strips, which shall be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut Fiber:** Coconut fiber blankets shall be machine-produced mats of 100% coconut fiber with biodegradable netting on the top and bottom. The coconut fiber shall be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket shall be of consistent thickness. The coconut fiber shall be evenly distributed over the entire area of the blanket. Coconut fiber blanket shall be furnished in rolled strips a minimum of 6.5 feet wide, a minimum of 80 feet long and a minimum of 0.05 lbs/ft². Coconut fiber blankets shall be secured in place with wire staples. Staples shall be made of 0.12-inch steel wire and shall be U-shaped with 8-inch legs and a 2-inch crown.
- **Coconut Fiber Mesh:** Coconut fiber mesh is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- **Straw Coconut Fiber:** Straw coconut fiber blankets shall be machine-produced mats of 70% straw and 30% coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber shall be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket shall be of consistent thickness. The straw and coconut fiber shall be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket shall be furnished in rolled strips a minimum of 6.5 feet wide, a minimum of 80 feet long and a minimum of 0.05 lbs/ft². Straw coconut fiber blankets shall be secured in place with wire staples. Staples shall be made of 0.12-inch steel wire and shall be U-shaped with 8-inch legs and a 2-inch crown.

Non-Biodegradable Blankets and Mats

Non-biodegradable blankets and mats are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the blanket. Netting used to hold these fibers together is typically non-biodegradable.

- **Plastic Netting:** Plastic netting is a lightweight biaxially-oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- **Plastic Mesh:** Plastic mesh is an open-weave geotextile that is comprised of an extruded synthetic fiber woven into a mesh with an opening size of less than 0.2 inch. It is used with revegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- **Synthetic Fiber with Netting:** Synthetic fiber with netting is a mat that is comprised of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three-dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be revegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- **Bonded Synthetic Fiber:** This type of product consists of three-dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than ninety percent open area, which facilitates root growth. Its tough root-reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Combination Synthetic and Biodegradable Blankets and Mats

Combination synthetic and biodegradable blankets and mats consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high-strength continuous-filament geomatrix or net stitched to the bottom. The material is designed to enhance revegetation. The material is furnished in rolled strips, which shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Construction Specifications/Installation:

Site Preparation

- Proper site preparation is essential to ensure complete contact of the protection matting with the soil.
- Grade and shape area of installation.
- Remove all rocks, clods, vegetative, and other obstructions so that the installed blankets, or mats will have direct contact with the soil. Prepare seedbed by loosening 2-3 inches of topsoil above final grade.
- Incorporate amendments, such as lime and fertilizer, into soil according to soil test and the seeding plan.

Seeding

- Seed area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all check slots and other areas disturbed during installation must be reseeded.
- Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Anchoring

- Anchoring of blankets and mats is the most critical element of installation. Anchoring devices must be selected to be compatible with site soil conditions.
- Where soil conditions are suitable (i.e., topsoil without substantial rocks or cobbles), biodegradable stakes, staples, or pins are preferred. Although biodegradable anchoring devices are preferred they must be compatible with soil conditions to ensure proper blanket installation.
- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples shall be a minimum of 11 gage. Metal stake pins shall be 3/16 inches diameter steel with a 1½ inch steel washer at the head of the pin. Wire staples and metal stakes shall be driven flush to the soil surface. Two inches of wood staking shall remain above the soil surface. All anchors shall be 6-18 inches long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils. See Table EP-10.1 for staking specifications.

TABLE EP-10.1. RECOMMENDATIONS FOR STAKE SELECTION	
Stake Length	Soil Conditions
6 inches	Typical soil conditions. 6-inch staples used in all but loose soil types.
8 inches	Loam, relatively loose sandy loam to sandy soils. 8-inch staples are typically used in high velocity channel applications.
> 12 inches	Excessively loose soils, slopes containing fine silt, sand, or soft mud. Deep and soft fills, loose sands, silts, loams or "quick" conditions. 12-inch staples and longer are used in shoreline applications in which wave action is a factor or in instances where soils remain saturated for long periods of time.

Installation on Slopes

- Dig initial anchor trench 12 inches deep and 6 inches wide across the channel at the lower end of the project area.
- Begin at the top of the slope and anchor the blanket in a 6 inch deep x 6 inch wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of the water flow.
- The edges of adjacent parallel rolls must be overlapped 2-3 inches and be stapled every 3 feet.
- When blankets must be spliced, place blankets end over end (shingle style) with a minimum of 6 inches overlap. Staple through overlapped area, approximately 12 inches apart.
- Lay blankets loosely and maintain direct contact with the soil - do not stretch.
- Blankets shall be stapled sufficiently to anchor blanket and maintain contact with the soil in accordance with manufacturer's specifications. Guidelines for installation are as follows: Staples shall be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1H:1V to 2H:1V, require 2 staples per square yard. Moderate slopes, 2H:1V to 3H:1V, require 1-2 staples per square yard (1 staple, 3 feet on center). Gentle slopes require 1 staple/yd². See Table EP-10.2 for matting specifications.

TABLE EP-10.2. MATTING SPECIFICATIONS

Matting Type	Slope/Channel Application	Netting Type
Straw	3H:1V or less	Type 1: Photodegradable polypropylene top/bottom Type 2: 100% biodegradable (use near sensitive habitat areas)
Straw/Coconut	2H:1V or less	Type 1: Photodegradable polypropylene top/bottom Type 2: 100% biodegradable (use near sensitive habitat areas)
Coconut	1H:1V or less Low-flow channels	Type 1: Photodegradable polypropylene top/bottom Type 2: 100% biodegradable (use near sensitive habitat areas)
Jute	3H:1V or less Short 2H:1V slopes	100% biodegradable (not to be used as a sole treatment for groundcover)
Excelsior	2H:1V or less, low-flow channel	Photodegradable extruded plastic mesh top/bottom
Coir fabric	1H:1V or less 8-10 fps channel	Type 1: 1-inch grid, 100% biodegradable (4-10 year life) Type 2: ½-inch grid, 100% biodegradable (4-10 year life) Type 3: ¼-inch grid, 100% biodegradable (4-10 year life)
TRM	High-flow (8-20 fps) channels	Three-dimensional synthetic polyolefin fibers mechanically bonded between two nets

Installation in Channels

- See channel preparation in Grass-Lined Channel (Turf Reinforcement Mats) (RC-5).

Soil Filling (if specified after turf reinforcement installation)

- After seeding, spread and lightly rake 1/2-3/4 inches of fine topsoil into the mat apertures to completely fill mat thickness. Use backside of rake or other flat implement.
- Spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.

- Do not drive tracked or heavy equipment over mat. Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes or brooms for fine grading and touch up.
- Smooth out soil filling, just exposing top netting of matrix.

Alternate Installation Method for Slopes <4H:1V

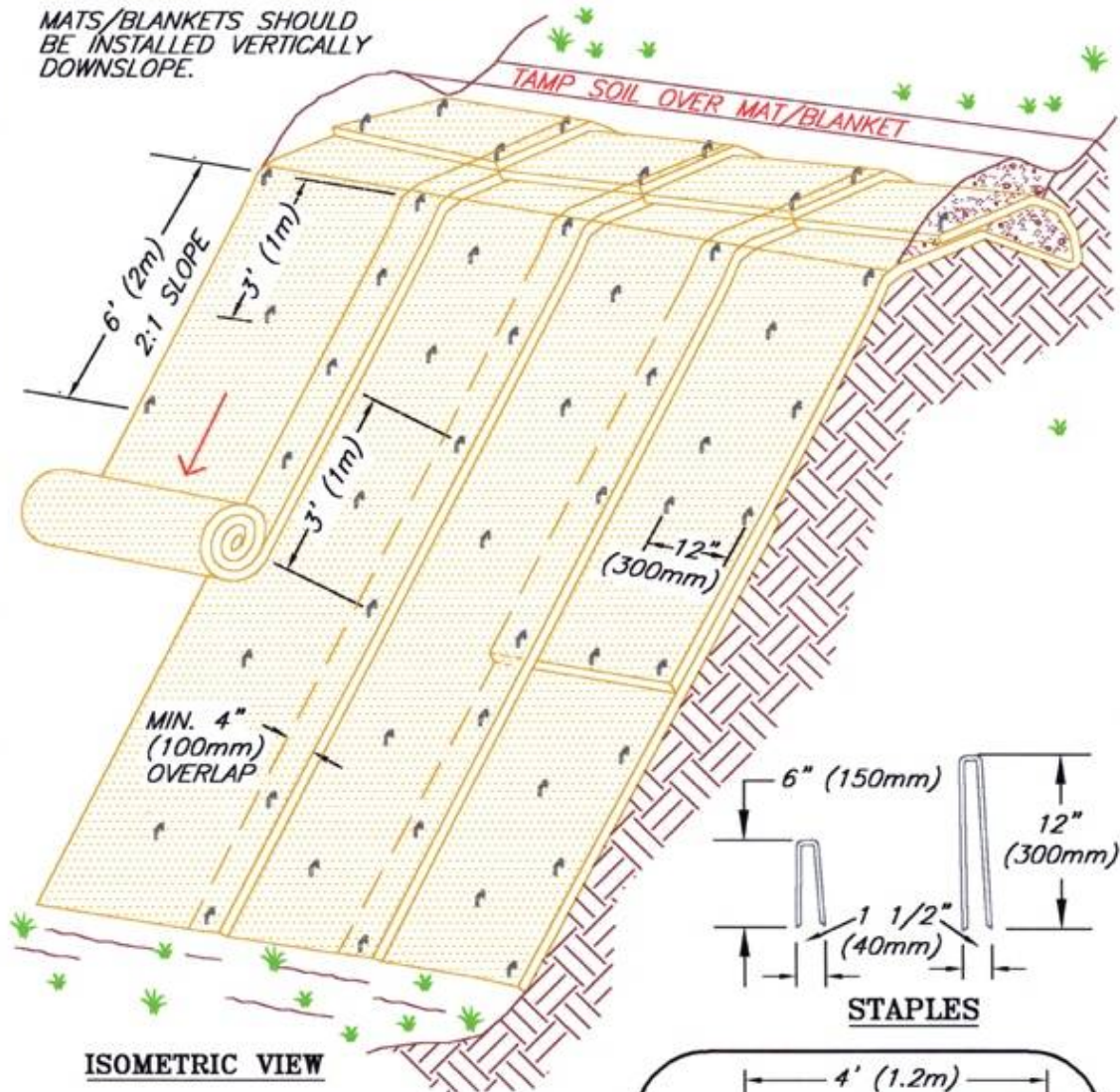
- Place two rows of anchors on 6-inch centers at 25-30 foot intervals in lieu of excavated check slots.
- Shingle-lap spliced ends by a minimum of 1 foot with upstream mat on top to prevent uplifting by water or begin new rolls in a check slot. Anchor overlapped area by placing two rows of anchors, 1 foot apart on 1 foot intervals.
- Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.
- Anchor, fill and compact upstream end of mat in a 12-inch x 6-inch terminal trench.
- Secure mat to ground surface using U-shaped wire staples geotextile pins or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Monitoring/Maintenance:

- All blanket and mats shall be inspected following installation and in accordance with approved plan and permit requirements.
- Inspect installation before, during, and after storm events to check for erosion and undermining. Any failure shall be repaired immediately.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or drainageway.

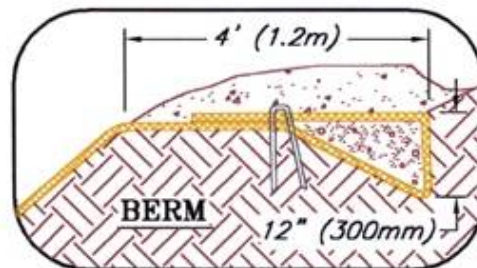
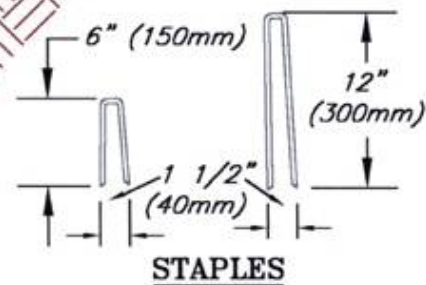
Common Failures: A frequent cause of failure is poor installation and maintenance.

MATS/BLANKETS SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.



ISOMETRIC VIEW

TYPICAL SLOPE
SOIL STABILIZATION



NOT TO SCALE

NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.

**EROSION BLANKETS &
TURF REINFORCEMENT MATS
SLOPE INSTALLATION**

SOIL BINDERS – EP-11

Application: Soil binders (also known as hydraulic soil stabilizers) are materials that are applied to the soil surface for dust control and temporary erosion control. When used in combination with plant materials (hay/straw) and hydraulic mulches, hydraulic soil stabilizers glue the mulch fibers together and are effective in controlling water-generated erosion.

Design Guidelines:

- Site-specific soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces, and conform to the following:
 - Stabilizing emulsion shall be a concentrated liquid chemical that forms a plastic film upon drying and allows water and air to penetrate.
 - Stabilizing emulsion shall be nontoxic to plant or animal life and nonstaining to concrete or painted surfaces. In the cured state, the stabilizing emulsion shall not be re-emulsifiable.
 - Stabilizing emulsion shall be miscible with water at the time of mixing and application.
 - A certificate of compliance for stabilizing emulsion shall be furnished to the City, as required.
- Select a soil binder that is compatible with existing vegetation.
- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.

Selecting a Soil Binder

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied; determine if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.
- Cure Time – Consider cure time and minimum drying time in binder selection. Refer to Table EP-11.1 and confirm cure time and minimum drying time with manufacture's recommendations.

Materials/Equipment: Hydraulic soil stabilizers can be used in basically three types of applications:

- As a standalone application of liquid that forms a crust on the soil surface by binding soil particles together.
- As a tackifying agent applied over straw mulch as an alternative to crimping.
- In combination with hydraulic mulches to create a hydraulic matrix.

In general, there are four common classes of hydraulic soil stabilizers (see Table EP-11.2 for comparisons):

- Plant-Material Based (Short Lived)—Guar, Psyllium, Starch, Chitosan.
- Plant-Material Based (Long Lived)—Pitch and Rosin Emulsion.

- Polymeric Emulsion Blends—Acrylic Copolymers and Polymers, Liquid Polymers of Methacrylates and Acrylates, Copolymers of Sodium Acrylates and Acrylamides, Poly-Acrylamide and Copolymer of Acrylamide, and Hydro-Collid Polymers.
- Cementitious-Based Binders—Gypsum.

TABLE EP-11.1. PROPERTIES OF SOIL BINDERS FOR EROSION CONTROL				
Chemicals	Plant Material Based (Short Lived)	Plant Material Based (Long Lived)	Polymeric Emulsion Blends	Cementitious-Based Binders
Relative Cost	Low	Low	Low	Low
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9-18 hrs	19-24 hrs	0-24 hrs	4-8 hrs
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean-Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies ¹	Varies ¹	Varies ¹	4,000-12,000lb/ac
¹ Dependant on product, soil type, and slope inclination				

TABLE EP-11.2. COMPARATIVE SELECTION CRITERIA—SOIL BINDERS

Soil Binder (with out mulch)	Unit Cost Installed	Relative Erosion Control	Degradability/ Longevity	Water Quality Impact	Ease of Cleanup	Mode of Application	Effect on Runoff	Drying Time (hrs)
Plant Material-Based (PBS) Guar, Psyllium, Starch, Chitosan	\$700-900/ac	85-95%	3-6 mo	+	+	B	0/-	12-18
Plant Material-Based (PBL) Pitch or rosin-based	\$1,200-1,500/ ac	60-65%	6-12 mo	-	V	B	+	19-24
Polymeric Emulsion Blends (PEB) Acrylic copolymers, copolymers and hydrocolloids Polyacrylamides (PAM)	\$700-1,500/ac	30-95%	1-2 yrs	V	V	B	+ and/or – depending on chemistry	4-24 Depending on chemistry
Cementitious Binder- Based (CBB) Generally used with trace mulch	\$800-1,200/ac	75-85%	1-2 yrs	+	V	H	+	4-8

Criteria Definition

Unit Cost Installed:	Cost of materials and labor to effect installation on a per acre basis
Relative Erosion Control:	Reduction in soil loss when binder compared to bare soil (control) under similar conditions of soil, slope length and steepness and rainfall simulation
Degradability/Longevity:	Based on manufacturers' standard recommended application rate and information/data sheets
Water Quality Impact:	Low, Medium or High based on the results of testing at the SDSU Soil Erosion Research Laboratory for Caltrans (See SSTS 1999). For detailed information on chemical constituents, ask the manufacturer for MSDS sheets and evidence of water quality testing.
Ease of Cleanup:	Positive (+) indicates that cleanup of overspray onto sidewalks, walls, etc. is generally not an issue. Negative (-) indicates that cleanup can be problematic. Variable (V) indicates that the chemistry of the particular binder can make a difference. Check with the manufacturer.
Mode of Application:	Indicates whether or not specific application equipment is required. Hydromulcher (H) indicates the need to mix and keep material in suspension by internal agitation; Water truck (W) means that the material is specifically designed for use with a standard water tank truck; Both (B) means that the material can be used in either a hydromulcher or a water truck with a recirculation pump or other means of preliminary mixing of binder with water.
Effect on Runoff:	A positive sign (+) indicates runoff is increased; a negative sign (-) means runoff is reduced; the symbol (0) indicates no-effect.

Source: Erosion Control Pilot Study Report, Caltrans, June 2000, and Soil Stabilization for Temporary Slopes, Caltrans 1999. Adapted and Updated January 2005.

Construction Specifications/Installation:

The soil binders in Table EP-11.1 will be generally appropriate as follows:

Plant-Material Based (Short Lived)

- **Guar:** Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It shall be diluted at the rate of 1-5 lbs per 100 gallons of water,

depending on application machine capacity. Minimum application rates are as follows (follow manufacturers recommended application rates):

APPLICATION RATES FOR GUAR SOIL STABILIZER					
Slope (H:V)	Flat	4:1	3:1	2:1	1:1
lb/ac	40	45	50	60	70

- **Psyllium:** Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but re-wettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12-18 hours drying time. Psyllium shall be applied at a rate of 80-200 lbs/acre, with enough water in solution to allow for a uniform slurry flow.
- **Starch:** Starch is non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lbs/acre, with an approximate drying time of 9-12 hours.

Plant-Material Based (Long Lived)

- **Pitch and Rosin Emulsion:** Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin shall be a minimum of 26% of the total solids content. The soil stabilizer shall be non-corrosive, water-dilutable emulsion that upon application cures to a water-insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and shall be applied as follows:
 - For clayey soil: 5 parts water to 1 part emulsion.
 - For sandy soil: 10 parts water to 1 part emulsion.
- Application can be by water truck or hydraulic seeder with the emulsion/product mixture applied at the rate specified by the manufacturer. The approximate drying time is 19-24 hours.

Polymeric Emulsion Blends

- **Acrylic Copolymers and Polymers:** Polymeric soil stabilizers shall consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound shall be handled and mixed in a manner that will not cause foaming or shall contain an anti-foaming agent. The polymeric emulsion shall not exceed its shelf life or expiration date; manufacturers shall provide the expiration date. Polymeric soil stabilizer shall be readily miscible in water, non-injurious to seed or animal life, non-flammable, shall provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and shall not re-emulsify when cured. The applied compound shall air cure within a maximum of 36-48 hours. Liquid copolymer shall be diluted at a rate of 10 parts water to 1 part polymer and applied to soil at a rate of 1,175 gallons/acre.
- **Liquid Polymers of Methacrylates and Acrylates:** This material consists of a tackifier/sealer that is a liquid polymer of Methacrylates and Acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. The drying time is 12-18 hours after application.
- **Copolymers of Sodium Acrylates and Acrylamides:** These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

APPLICATION RATES FOR COPOLYMERS OF SODIUM ACRYLATES AND ACRYLAMIDES	
Slope Gradient (H:V)	lb/ac
Flat to 5:1	3-5
5:1 to 3:1	5-10
2:1 to 1:1	10-20

- **Poly-Acrylamide and Copolymer of Acrylamide:** Linear copolymer polyacrylamide is packaged as a dry-flowable solid. When used as a stand-alone stabilizer, it is diluted at a rate of 1 lb/100 gallons of water and applied at the rate of 5 lbs/acre.
- **Hydro-Colloid Polymers:** Hydro-Colloid Polymers are various combinations of dry-flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 53-62 lbs/acre. The drying time is 0-4 hours.

Cementitious-Based Binders

- **Gypsum:** This is a formulated gypsum-based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000-12,000 lb/acre. The drying time is 4-8 hours.

Soil Binder Applications

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps shall be followed:

- Follow manufacturer's recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where rolling is impractical.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders shall not be applied during or immediately before rainfall.
- Avoid over-spray onto the traffic areas, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- Soil binders shall not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the air temperature is below 40 °F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure times.
- For liquid agents:
 - Crown or slope ground to avoid ponding.
 - Uniformly pre-wet ground at 0.03-0.3 gallons/yd² or according to manufacturer's recommendations.
 - Apply solution under pressure. Overlap solution 6-12 inches.
 - Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
 - In low humidities, reactivate chemicals by re-wetting with water at 0.1-0.2 gallons/yd².

Monitoring/Maintenance:

- Reapplying the selected soil binder may be needed for proper maintenance. Inspections shall be conducted prior to and after rain events greater than ½ inch within 24-hours, and shall be performed no less than daily in high traffic areas and weekly in lower traffic areas.
- After any rainfall event, maintain all slopes to reduce or prevent erosion.
- Maintain a continuous, temporary stabilized area while disturbed soil areas are non-active. Repair any damaged stabilized area and re-apply soil binder to exposed areas.

STABILIZATION MATS – EP-12

Application: There are several techniques that involve the placement of relatively inexpensive and locally available material to stabilize the ground surface, especially for work around sensitive areas such as wetlands and streams. Stabilization mats reduce tracking from the construction site and create a stable pad for heavy equipment.

Materials/Equipment: Types of stabilization mats to consider include brush mats, corduroy mats, and board mats:

- **Brush Mats:** Brush mats are constructed of available slash (brush and trees), crushed in-place to form a mat. Their purpose is to support equipment so that there are minimal short term impacts in excessively wet conditions. This practice is limited to areas where brush is of sufficient thickness and density to stabilize the wetland bottom for vehicular/equipment use. In some cases, the brush mats may be left behind to naturally decay, although it may take 8-12 years for them to decay completely. According to a study that examined the effects of brush mat use in wetlands, leaving them in place did not restrict water movement or alter water regimes, and revegetation occurred quickly. The use of brush mats can reduce the need for slash management.
- **Corduroy Mats:** Corduroy mats are constructed of small logs, brush, or mill slabs placed one after the other, perpendicular to the equipment driving path. These types of mats can spread the load over the entire area of the log or slab and are effective in increasing the load bearing capacity of an area. Flotation increases by using longer pieces of material, particularly small logs or mill slabs. These mats may be practical where logs are readily available. Multiple layers of corduroy may be required in some areas. The use of corduroy mats can reduce the need for slash management.
- **Board Mats:** Board mats consist of “pallet like” units placed one after the other to form a crude yet rapidly placed stabilized surface. Board mats can be placed, used, and easily removed for temporary stabilization for short term equipment use.

Construction Specifications/Installation:

- Installation varies, depending on construction methods and site conditions.
- Comply with applicable permits when using in wetlands or waters.

Monitoring/Maintenance:

- Corduroy mats, and board mats shall be removed upon completion of work activity. Removal activities shall be timed to minimize soil disturbance.
- Brush mats may be left to degrade in place if permitted by the regulatory agency.
- Evidence of increased sedimentation, flow disruption, or other adverse effects of using mats shall be periodically inspected for, including following significant rain events. Repairs or changes shall be made as needed.
- Equipment/vehicles using mats shall be checked for gas leaks and oil leaks.

Common Failures: A frequent cause of failure is poor maintenance.

WIND EROSION / DUST CONTROL – EP-13

Application: Wind erosion control consists of dust control applications to protect soil from wind erosion or prevent dust generation from construction activities and equipment due to dry soil conditions. Wind erosion and dust control methods consist of applying water over susceptible areas or applying other dust mitigation as approved by the City.

Design Guidelines: Daily dust control shall be provided as needed to stabilize soil from wind erosion and to reduce dust generated by construction activities. Screen water intakes at streams to protect fish and obtain appropriate water withdrawal permit. Special attention shall be paid to stockpiled materials. Covering of small stockpiles or areas is an alternative to applying water or other dust mitigation.

Materials/Equipment: Non-potable water conveyed in tanks, trucks, drainpipes, or other conveyances. Plastic or geotextile sheeting.

Construction Specifications/Installation:

Dust control shall be provided daily or more often (as deemed necessary based on wind conditions, time of year, and physical conditions of the site) by application of water alone or with addition of magnesium chloride or calcium chloride in accordance with manufacturer's specifications.

Acrylic co-polymers or other biodegradable products (soil stabilizers/tackifiers) may be used for daily dust control if approved by the City.

Water applied for dust control shall be applied evenly and without over watering, which generates runoff and may result in erosion by water.

Oil or other petroleum-based products shall not be used for dust control.

Dust control must be implemented in accordance with state air quality requirements.

Monitoring/Maintenance:

Check areas protected to ensure appropriate coverage.

Reapply water or maintain covers, as necessary to be effective.

Common Failures:

A frequent cause of failure is over watering or poor maintenance.

LIVE STAKING – EP-14

Application: Live staking involves the insertion of live, vegetative cuttings, usually willows, into the ground in a manner that allows the cutting (stake) to take root and grow. Live stakes can create a root mat that stabilizes the soil by reinforcing and binding soil particles together. The BMP is one of several biotechnical erosion control (also known as soil bioengineering) techniques to arrest and prevent slope failures and erosion. Live stake establishment can improve aesthetics and provide wildlife habitat. As a temporary measure, live staking performs an important function of stabilizing and modifying the soil. The technique uses cuttings that are relatively short and small in diameter. Pole Planting (EP-15) is a related technique; however, the poles are much longer and thicker.

Live stakes are appropriate for repairing small earth slips and slumps. The stakes can help buttress the soil and arching. Gullies and bare gully banks can benefit from live staking. Live stakes can be used to anchor and enhance the effectiveness of wattles, fascines, fiber rolls, turf reinforcement mats and other erosion control materials. Live stakes do not initially provide erosion control. They work best if used in conjunction with other erosion prevention techniques during establishment period.

Design Guidelines: Live stakes are planted with the terminal buds or leaf nodes pointing up and the basal ends down into the soil. The buried portion of the cuttings develop roots, while the exposed portion produces branches and leaves. Depending on the species, the cuttings can grow into shrubs and/or trees. Because of its ability to root easily, the preferred plant species for live staking is willow (*Salix* spp.), but cottonwood (*Populus* spp.), dogwood (*Cornus* spp.), elderberry (*Sambucus* spp.), and others have been used successfully.

Live stakes are useful for the following situations:

1. Live staking is useful as a revegetation technique and for establishing riparian plants in high flow or droughty situations.
2. Live staking can be used in irrigated or non-irrigated conditions with the latter being more prevalent. Irrigation can greatly increase vegetative success. Most often live staking is installed during the dormant season or when climatic or soil moisture conditions are favorable for establishment in non-irrigated conditions.
3. Live stakes provide an environmentally-sensitive anchoring technique for geotextiles and erosion control materials. The anchoring can be temporary or permanent depending on whether the stakes “take root.”
4. Adding immediate failure resistance to the soil mass. While providing geotechnical benefits by “buttressing and arching,” deep-seated failure planes underneath the bottom end of the cuttings will not usually be affected by live staking. These plants can remove excess soil moisture via evapotranspiration during the growing cycle, however these benefits will not be realized during dormancy.

Materials/Equipment: Live stakes are pieces of freshly cut woody plant stems planted, inserted, or driven in the ground or placed into erosion control or streambank stabilization structures. The branches vary from about 18-36 inches long, and typically $\frac{3}{4}$ -3 inches in diameter. For Pole Planting (EP-15), the poles are much longer (3-15 feet long) and can be installed and arrayed differently.

Live stakes are typically made of woody riparian plant stems, although fleshy plant stems can have some success as well. Willow, cottonwood, and dogwood are the most used woody plants; however, willow cuttings make the best material for live stakes. Willow species are highly dependent on locale; the best species for a given site are those found growing near the site. Stakes are typically harvested and planted when the willows,

or other chosen species, are dormant, although the cuttings can do well other times of year when soil moisture is available.

When harvesting cuttings:

- Select healthy, live wood that is reasonably straight, and at least 2 years old.
- Make clean, angular cuts without splitting ends.
- Trim branches from cutting as closely as possible.
- Cuttings shall generally be $\frac{3}{4}$ inch in diameter and a minimum 18 inches long, or larger depending on the species.
- The butt end of the cutting shall be pointed or angled and the top end shall be cut square to help identify the top and bottom when planting.
- The top, square end can be painted and sealed by dipping the top 1-2 inches into a 50-50 mix of light colored latex paint and water. Sealing the top of stake will reduce desiccation, ensure the stakes are planted with the top up, and make the stakes more visible for subsequent planting evaluations.
- Stakes must not be allowed to dry out. All cuttings shall be soaked in water for 5-7 days (a minimum of 24 hours) and planted the same day they are removed from the water.

Construction Specifications/Installation:

- Use an iron stake or bar to make a pilot hole in firm soil.
- Plant the basal ends into the ground, with the leaf bud scars or emerging buds always oriented up. Be careful not to damage the buds, strip the bark, or split the stake during installation.
- The stakes shall not be planted in rows or at regular intervals, but at random in the most suitable places at a rate of 2-5 cuttings/10 ft². However, if trying to control a group of people planting several thousand stakes, it may be found that it is easier to specify an average set interval.
- Set the stake as deep as possible into the soil, with 80% of its length into the soil. Deep planting will increase the chances of survival. The stake shall never protrude more than 20% of its length above the ground level to prevent it from drying. The excess stake or any damage or split ends can be cut off after installation. At least 2 buds and/or bud scars shall remain above the ground after planting.
- Add soil to the planting hole if necessary to ensure soil contact with the stem. It is important to tamp the soil around the cutting to ensure good soil-stem contact. The best installations, especially on dry sites, will include “watering in” and slightly compacting the backfill or hole. “Watering in,” much like transplanting a container plant, can successfully be accomplished by pouring one to two gallons of water into the soil around the stake and planting hole, then slightly tamping or otherwise jarring the soil. This procedure will ensure complete soil to stem contact.

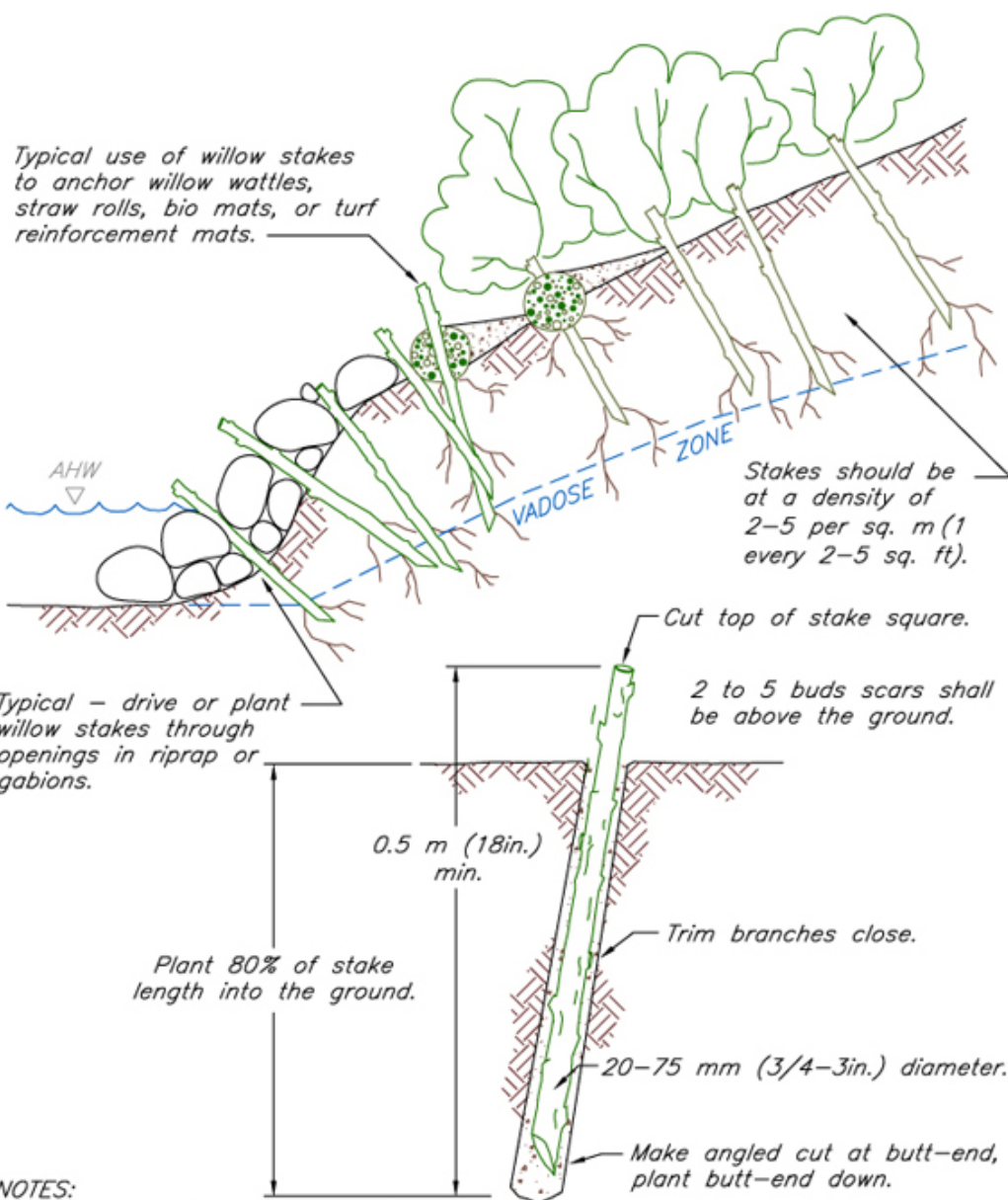
Monitoring/Maintenance:

Stakes shall be inspected every few weeks until well established, and irrigation, browse control (from livestock, deer, beavers, etc.), pruning, weed control, and fertilization shall be implemented as needed.

Common Failures:

Live staking can fail if vegetation is not handled properly prior to installation, is installed incorrectly (less than 80% of the cutting in the ground, bud scars facing down, poor soil contact, etc.) or not irrigated or “watered in” when installed in arid areas.

Another frequent cause of failure is poor maintenance.



NOTES:

1. Harvest and plant stakes during the dormant season.
2. Use healthy, straight and live wood at least 1 year old.
3. Make clean cuts and do not damage stakes or split ends during installation; use an iron bar and pilot hole in firm soils.
4. Soak cuttings for at least 24 hours prior to installation. Soak for 5-7 days for best results.
5. Tamp the soil around the stake.

FILE: LVSTK

LIVE STAKING AND JOINT PLANTING

Pole Planting – EP-15

Application: Pole plantings are one of several biotechnical erosion control (also known as soil bioengineering) techniques to arrest and prevent slope failures and erosion along streambanks; also used to enhance wildlife habitat and be aesthetically pleasing. The technique uses large diameter cuttings that are relatively long. The cuttings are intended to sprout and take root, stabilizing the streambank with a dense matrix of roots. Pole plantings are planted deep so they usually require heavy equipment assisted construction techniques. Live Staking (EP-14) is a related technique; however, the stakes are much shorter and can be installed manually.

Design Guidelines: Pole planting is suitable for floodplains, streambanks, and other riparian zones. Pole plantings are very useful for highly erodible areas and sites with fluctuating water tables. Pole planting is a useful "stand alone" revegetation technique for replacing and/or reestablishing riparian vegetation and cover. Pole planting is also particularly suitable for conjunctive uses with other streambank stabilization techniques such as vegetated riprap, vegetated gabions, rootwad revetments with vegetated riprap, vegetated deflectors, and longitudinal peaked stone toe protection.

Pole planting areas may need to be accessible to heavy equipment, as the poles shall be planted into deep holes. The location of the water table (saturated zone) and vadose zone (moist soil zone including the capillary fringe, located above the saturated zone) shall be approximately identified so the pole plantings can access sufficient moisture. Pole plantings are usually planted with a power auger or punch bar (Stinger).

Materials/Equipment: The cuttings usually are taken from willow (*Salix* spp.) or cottonwood (*Populus* spp.). Pole plantings use large diameter cuttings that are relatively long, straight, poorly branched stems, usually 5-10 feet in length. (For Live Staking (EP-14), the stakes are 18-36 inches long and can be installed and arrayed differently.)

A pond or storage area for soaking the cuttings will be necessary. Pole planting techniques may require the use of a power auger, stinger, or other method to excavate deep holes. The stinger is a large, pointed metal punch bar that is 4–6 inches in diameter, and mounted on a backhoe or hydraulic excavator.

Construction Specifications/Installation:

- Collect and harvest cuttings (ideally during the dormant season) and then soak the poles for 5-7 days.
- Plant poles into an augured, punched, or excavated hole. The holes shall extend to approximately 1 foot above the water table and through the vadose zone. This depth can be difficult to determine in areas with reservoirs and streams with widely fluctuating seasonal water levels. In this case, ensure that the ends of the poles reach the low waterline at the time of planting if possible.
- Pole plantings shall ideally be installed during the construction of structures. For instance, plant the poles with the placement of riprap, especially into any trenches excavated for keyways or scour trenches. Another example is to plant the poles during riprap placement such that the poles extend through the riprap and backfill and into contact with the "native" bank.
- The backfill can be placed over and around the poles rather than having to "punch" holes through the riprap. Another method is to plant the poles during gabion construction.

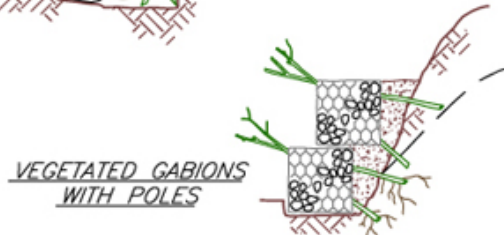
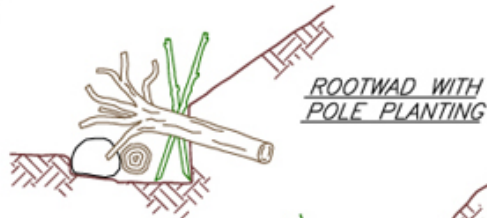
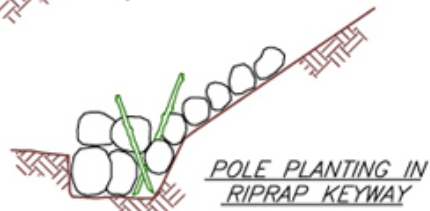
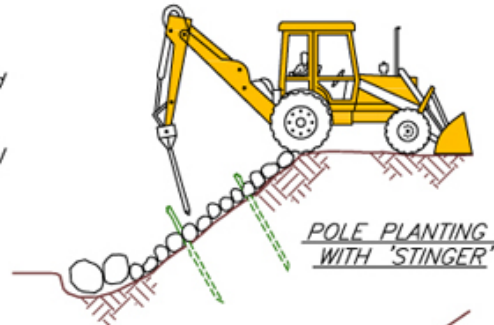
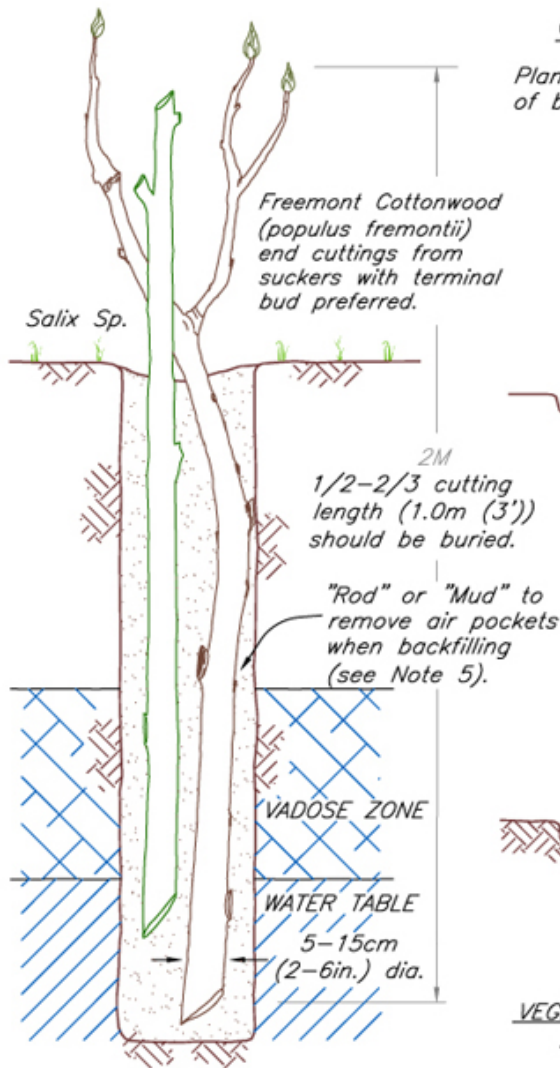
- The pole plantings, especially the basal ends, must have good contact with the soil. "Mud" the hole (fill the hole with water and then add soil to make a mud slurry) to remove air pockets.

Monitoring/Maintenance: Poles shall be inspected every few weeks until well established, and irrigation, browse control (from livestock, deer, beavers, etc), pruning, weed control, and fertilization shall be implemented as needed.

Common Failures: A frequent cause of failure is poor maintenance.

CONSTRUCTION TECHNIQUES

Plant poles deeply during construction of biotechnical streambank work.



NOTES:

1. Pole cuttings of willow or cottonwood are longer and have a larger diameter than branch cuttings or live stakes.
2. Larger diameter cuttings have a greater supply of stored energy (stored photosynthesis) than smaller diameter cuttings.
3. Pole cuttings are better suited for highly erodible areas and sites with fluctuating water levels.
4. The pole cuttings should extend through the vadose zone and into the permanent water table. At least 1/2 to 2/3 of the pole should be below the ground, at least 1.0 m (3 ft.), and long enough to emerge above adjacent vegetation.
5. "Muddying" - filling the hole with water and then soil to make a mud slurry can remove air pockets.

WILLOW POSTS & POLES

Live Fascines and Brush Wattles – EP-16

Application: Live fascines and brush wattles are bundles of live branch cuttings placed in long rows in shallow trenches across the slope on contour or at an angle. They are used for biotechnical stabilization of slopes and streambanks to arrest and prevent slope failures and erosion; also used to enhance wildlife habitat and be aesthetically pleasing.

- Fascines consist of bundles of straight, long, and slender branches of shrubs and trees capable of propagation, usually willows, which are packed together in rolls that are secured with twine or rope. Fascines are prepared and installed differently from wattles in that they are assembled with the branches and bud ends oriented in the same direction.
- Brush wattles consist of bundles of straight, long, and slender branches of shrubs and trees capable of propagation, usually willows, which are packed together in rolls that are secured with twine or rope. Wattles are prepared and installed differently from fascines in that they are assembled with the branches and bud ends oriented in alternating directions.

Design Guidelines: The technique is applicable where immediate erosion protection is necessary. This technique works best where flows are sufficient to keep the base of the bundle wet during most of the growing season, but do not exceed the flood tolerance of the fascine.

- Fascines are appropriate for use on slopes where the woody branch bundles shall be placed on a gradient for intercepting and transporting surface and shallow subsurface drainage. Fascines are preferable over brush wattles in areas with high rainfall, deep snow pack or where the collection of excess water on the slope may not be desirable.

Fascine spacing and configuration vary depending upon slope, exposure, and purpose:

- To treat overbank runoff on upper and mid bank areas, rows are installed on the contour.
- To divert runoff in upper and mid bank areas, rows are installed on a gradient.
- To trap sediment, rows are installed along the uphill side of v-ditch or other drainage structures.
- For flood flow protection, rows are installed perpendicular to flow in midbank areas.
- To treat wave erosion, rows are installed parallel to waves.
- On outer bends, and moist, seeping banks, fascines shall be installed at an angle of 45°-60° from horizontal, with the bud ends at the top, pointing upstream. On drier banks, and inner bends, fascines shall be installed on contour.
- Wattles are appropriate for use on long slopes, road cuts, gullies, slumped areas, eroded slopes, or eroding streambanks. Wattling may be used to stabilize entire cut or fill slopes or localized gully areas of slopes. Wattles may be used to repair small earth slips and slumps or to protect slopes from shallow slides 1–2 feet in depth. Wattles may be installed on newly built slopes or as remedial action on existing slopes. Wattling facilitates the natural invasion and establishment of plants from the surrounding plant community. Also see Fiber Rolls or Wattles (SC-7).

- Fascines and Brush Wattles are preferable over fiber rolls for slope interruption where it is feasible and desirable to establish shrubs on the slope using biotechnical erosion control techniques. Fascine drains can be used on wet slopes where there is evidence of subsurface seepage that is exacerbating erosion control problems. Also see Fascines with Subdrain (EP-18).

The condition of adjacent sites, including identifying successful plant species, growth form, and soil types, shall be assessed and compared to conditions on the construction site prior choosing fascine and wattle plant species.

Materials/Equipment: Fascines are made of brushy cuttings (stems that have leaves and twigs) of tree and shrub species capable of vegetative propagation, typically willow species. Plant material harvest and installation must be performed during its dormant season, late fall through early spring, or at other times of year if water is available. The cuttings shall be long, a minimum of 3 feet, straight brushy branches up to 1½ inch in diameter. For optimum success, the fascines shall be soaked for 24 hours or installed on the same day they are harvested and prepared.

Construction Specifications/Installation:

- Cuttings shall be tied together to form bundles, tapered at each end, 6-30 feet in length, depending on site conditions or limitations in handling. The completed bundles shall be 6-12 inches in diameter, with the growing tips and butt ends oriented in alternating directions (for fascines, ends oriented in the same direction).
- Stagger the cuttings in the bundles so that the tips are evenly distributed throughout the length of the bundle.
- Compress and tightly tie the bundle every 1 foot with rope or twine of sufficient strength and durability. Hemp, jute, cotton or other biodegradable rope may be used.
- Installation progresses from the bottom to the top of the slope.
- Install bundles into trenches dug into the slope on contour.
- Spacing of contour trenches (fascines) is determined by soil type, potential for erosion and slope steepness. See Table EP-16.1 below for general spacing guidelines.

TABLE EP-16.1. GENERAL INSTALLATION GUIDELINES	
Slope (H:V)	Slope Length Between Fascines (ft)
1:1 to 1.5:1	3-4
1.5:1 to 2:1	4-5
2:1 to 2.5:1	5-6
2.5:1 to 4:1	6-8
3.5:1 to 4:1	8-12
4.5:1 to 5:1	10-20

- The trench shall be shallow, about ½ the diameter of the fascine. The trench width will vary from 12-18 inches depending on the slope angle, but shall be at least 1 inch wider than the bundle.
 - In non-cohesive soils, the trench shall be lined with a coir erosion control blanket or netting prior to installation of the fascine.

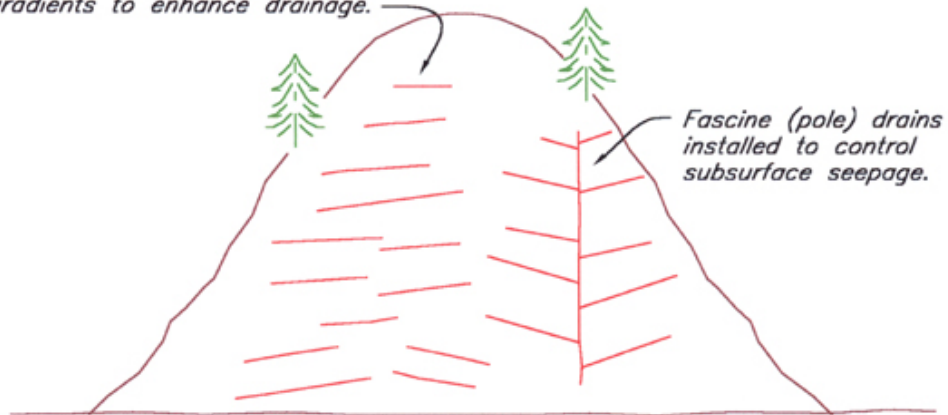
- Fascines shall be staked firmly in place with one row of construction stakes on the downhill side of the bundle, not more than 3 feet apart. A second row of stakes shall be placed through the fascines, near the ties, at not more than 5 feet apart.
- Overlap the tapered ends of adjacent bundles at least 18 inches so the overall thickness of the fascine is uniform.
- Two stakes shall be used at each bundle overlap, such that a stake may be driven between the last two ties of each bundle. Live stakes, if specified, are generally installed on the downslope side of the bundle.
- Drive the live stakes below and against the bundle between the previously installed construction stakes.
- Repeat the proceeding steps to the top of the slope, placing moist soil along the sides of the live bundles.
- When finished, all live stakes shall be trimmed, such that a maximum of 3 inches of stake protrudes above the bundle.
- Fascines shall be keyed into the bank at least 3 feet on both upstream and downstream ends.
- Proper backfilling is essential to the successful rooting of the fascine.
- Backfill bundles with soil from the slope or trench above. The backfill shall be worked into the fascine interstices and compacted behind and below the bundle by walking on and working from its terrace.
- Seed and mulch the slope. Shallow slopes, generally 3H:1V or flatter may be seeded and mulched by hand. Steeper slopes can have seed applied hydraulically and the mulch shall be anchored with tackifier or other approved methods.

Monitoring/Maintenance: Inspections shall occur after each of the first few floods, and/or twice the first year, and at least once each year thereafter.

Common Failures: Toe erosion and/or flanking can cause loss of the structure, if not combined with a toe protection in areas where shear stresses and velocities exceed limits for the soils underlying the structure. Flanking can be caused by insufficient keying-in of the structure.

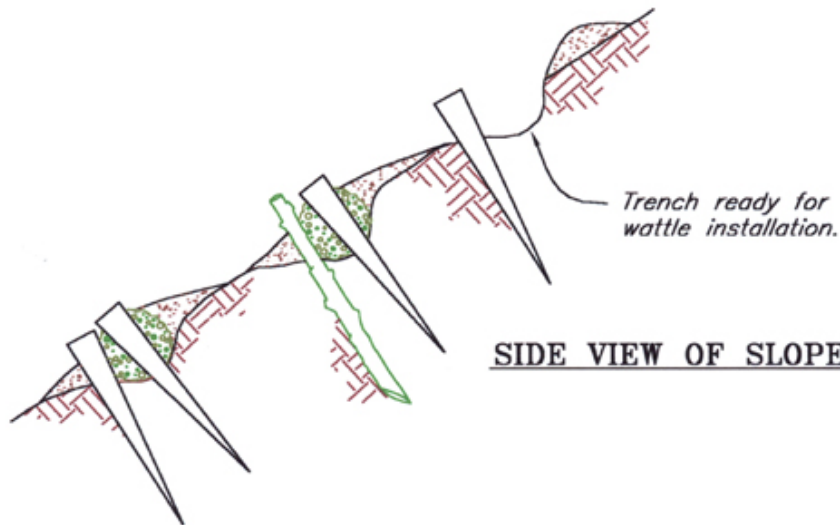
Another frequent cause of failure is poor maintenance.

Fascines placed in trenches on slope face along shallow gradients to enhance drainage.

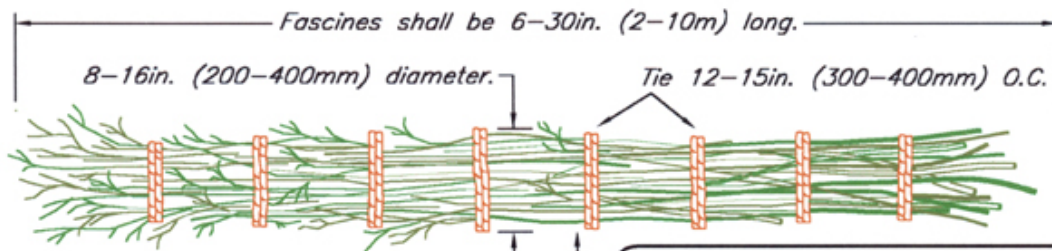


Fascine (pole) drains installed to control subsurface seepage.

FRONT VIEW OF SLOPE



SIDE VIEW OF SLOPE



Prepare fascines with 1/4-1/2in. (6-40mm) cuttings, with all bud ends facing the same way.

LIVE FASCINE

NOT TO SCALE

Brush Box – EP-17

Application: Brush boxes are toe wall or breast wall type retaining structures constructed with branch cuttings, wooden construction stakes, and wire. The BMP is one of several biotechnical erosion control (also known as soil bioengineering) techniques to arrest and prevent slope failures and erosion; also used to enhance wildlife habitat and be aesthetically pleasing.

Design Guidelines: Brush boxes are best if constructed on firm ground at the toe of a small slump or along the toe of an oversteepened stream bank. Brush boxes require minimal excavation and require fill behind them. Brush boxes are larger and stronger than wattles and are therefore more suitable for buttressing the base of a slope.

Materials/Equipment: The ideal plant materials for brush boxes are those that: (1) root easily; (2) are long, straight and flexible; (3) are adapted to the site conditions; and (4) are plentiful near the job site.

Willow (*Salix* spp.) makes ideal cutting material. Some species of dogwood (*Cornus* spp.) and cottonwood (*Populus* spp.) also have very good rooting ability.

The cuttings shall be very long, 6-12 feet at a minimum, with straight branches up to 1½ inches in diameter. Trimmings of young suckers and some leafy branches may be included in the bundles to aid filtration. The number of stems varies with the size and kind of plant material. If willow or other rootable species are in short supply, non-rooting woody material may be used to partially fill the box (up to 50%).

Brush boxes require sturdy construction stakes, cut on a diagonal from vertical grained wood capable of being driven into the ground. Cut stakes at least 3 feet long. Wire, usually 9 gage or heavier, is required to bind the tops of the stakes together.

Construction Specifications/Installation:

- Work shall start at the bottom of the slope. Perform any slope repairs, such as runoff diversions (RC-3 and RC-4), prior to brush box installation.
- Dig a trench 12-18 inches wide and approximately 12 inches deep along the toe of the slump or stream bank.
- Drive construction stakes, 36-48 inches long, into the soil adjacent to the trench wall across from each other, one on the downhill side of the trench and one on the uphill side of the trench. Repeat the procedure by driving pairs of stakes every 2 feet along the length of the trench. Cut small notches into the stakes, approximately 3 inches from the top.
- Place the cuttings immediately after trenching to reduce desiccation of the soil. Cuttings shall be placed together between the stakes with the growing tips and butt ends oriented in alternating directions. Stagger the cuttings in the box so that the tips are evenly distributed throughout the length of the brush box.
- Compress the cuttings tightly between the stakes and tie the pair of stakes and cuttings together with a strong galvanized wire. Wrap the wire tightly around the stakes at the notches and twist the wire between the stakes to “cinch” the cuttings down. Drive the stakes further into the soil. This procedure will tighten the wires and compress the cuttings into the trench.
- Proper backfilling is essential to the successful rooting of the brush box. Backfill with soil graded from the slope above. Place moist soil along the sides of the live box. The backfill shall be worked into the

cutting interstices during construction and compacted behind and below the bundle by walking on and working from brush box terrace.

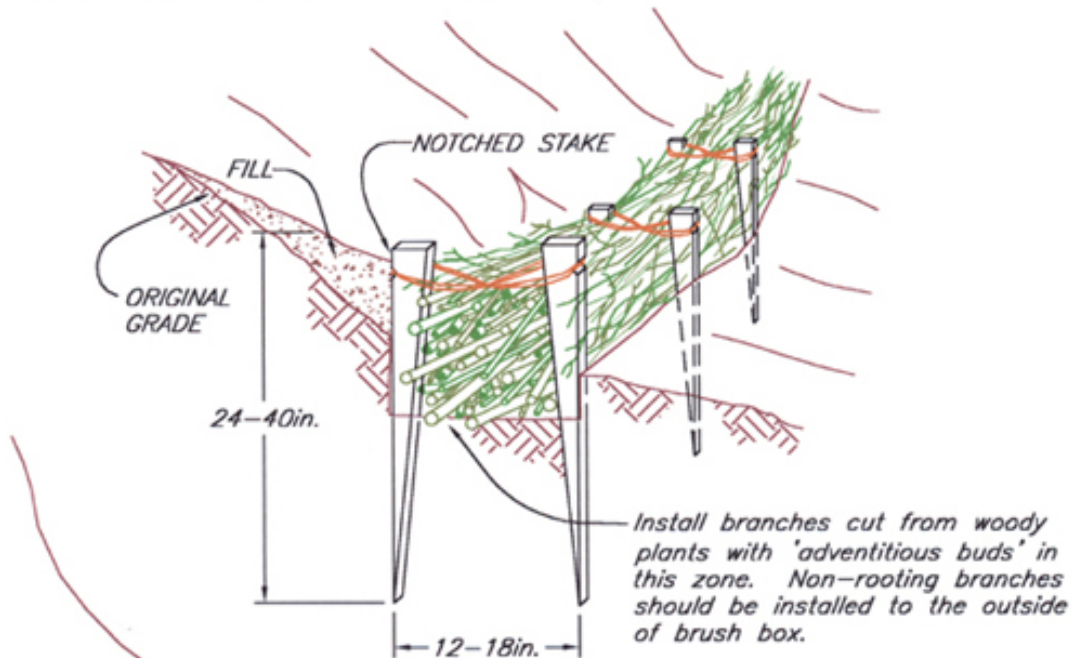
- Repeat the proceeding steps to the top of the slope. The top of the brush box shall be slightly visible when the installation is completed.

Monitoring/Maintenance: Brush boxes shall be inspected every few weeks until well established, and irrigation, browse control (from livestock, deer, beavers, etc), pruning, weed control, and fertilization shall be implemented as needed.

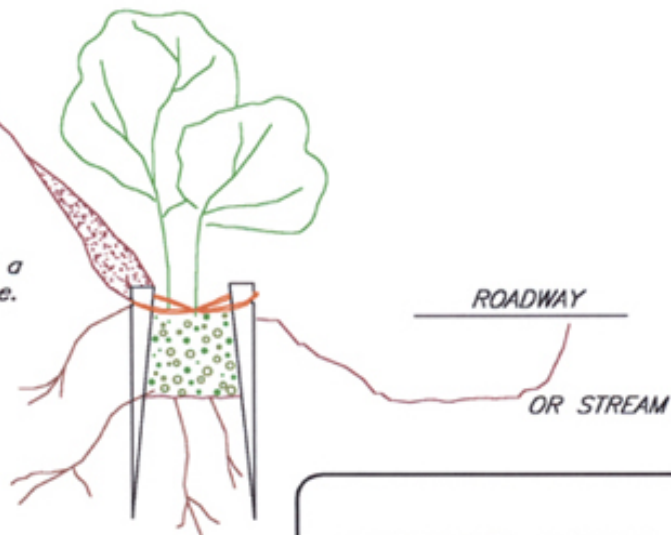
Common Failures: A frequent cause of failure is poor maintenance.

NOTES:

1. Branches from non-rooting species may be combined when woody plants capable of vegetative propagation (*Salix* sp., *Populus* sp., *Cornus* sp.) are in short supply.
2. Proper backfilling is essential to the successful rooting of the brush box. Backfill with soil from slope above. The backfill must be 'worked' into the branches interstices during construction.



Brush box at the toe of a slumping or raveling slope.



NOT TO SCALE

CROSS SECTION

BRUSH BOX

FASCINES WITH SUBDRAINS – EP-18

Application: Fascines with subdrains is an erosion prevention system for use in filled gully areas or tributary swales where groundwater is likely to collect and concentrate. The BMP is one of several soil bioengineering techniques to arrest and prevent slope failures and erosion; also used to enhance wildlife habitat and be aesthetically pleasing. Live fascines are intended to establish shrubs for biotechnical erosion control and are not removed at the end of construction.

Design Guidelines: Rows of fascines are installed on the contour of a slope in the conventional manner. In addition, a subsurface drain, oriented downslope and perpendicular to the fascines, is placed in a trench beneath the rows of fascines to intercept and collect seepage. The subsurface drain consists of a perforated pipe wrapped in a geo-composite drainage medium placed at the bottom of a trench. The trench is backfilled with clean, coarse aggregate or gravel.

The seepage collection trench is excavated first, and a perforated pipe wrapped in a composite geodrain is placed in the bottom of the trench. The trench is then backfilled with gravel or coarse aggregate. The fascines are installed over and across the trench and subsurface drain. Fascines are prepared and installed in the conventional manner as in EP-16. The geodrain is formed by first wrapping the perforated pipe in a three-dimensional open mat or matrix comprised of semi rigid polymeric fibers, e.g., Enkamat™, followed by another wrap of filter fabric or filter cloth. The porous core of the geocomposite shall face in towards the pipe, with the filter cloth backing facing outward. All drains shall be constructed and installed with clean-out access tubes. The perforated pipe in the subdrain shall have sufficient capacity to handle and transmit intercepted groundwater flow or seepage. Guidelines for computing the appropriate size can be determined from published nomographs. Normally, a 4-inch diameter polymeric pipe should suffice.

After construction of the drain trench, the live fascines are installed over the trench in the normal manner. Other than the presence of a clean out tube in the treatment including subsurface drainage, both techniques have the same external appearance.

Materials/Equipment: In addition to the live cuttings required for the fascines, materials are required for manufacturing the drains; that is, perforated polymeric pipe, filter cloth, and a turf reinforcement mat (e.g., Enkamat™) for wrapping the pipe. Stakes must not be allowed to dry out. All cuttings shall be soaked in water for 5-7 days (a minimum of 24 hours) and planted the same day they are removed from the water.

Construction Specifications/Installation:

- The seepage collection trench is excavated first, and a perforated pipe wrapped in a composite geodrain is placed in the bottom of the trench.
- The trench is then backfilled with gravel or coarse aggregate.
- The fascines are installed on contour over and across the trench and subsurface drain. Row spacing guidelines for fascine installations are presented in Table EP-18.1.

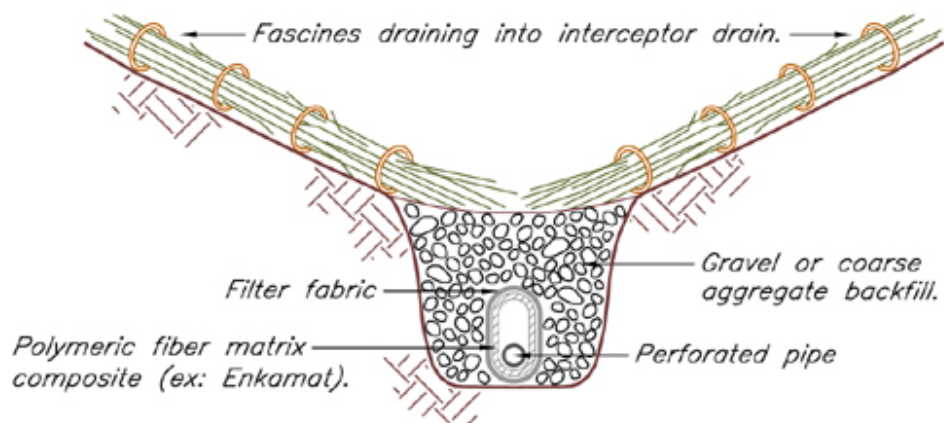
TABLE EP-18.1. RECOMMENDED SPACING FOR LIVE FASCINES ON SLOPES		
Slope Steepness (H:V)	Slope Distance Between Fascine Rows (ft)	
	On Contour	On Angle
1:1 to 1.5:1	3-4	2-3
1.5:1 to 2:1	4-5	3-5
2:1 to 2.5:1	5-6	3-5
2.5:1 to 3:1	6-8	4-5
3.5:1 to 4:1	8-9	5-7
4.5:1 to 5:1	9-10	6-8

Monitoring/Maintenance:

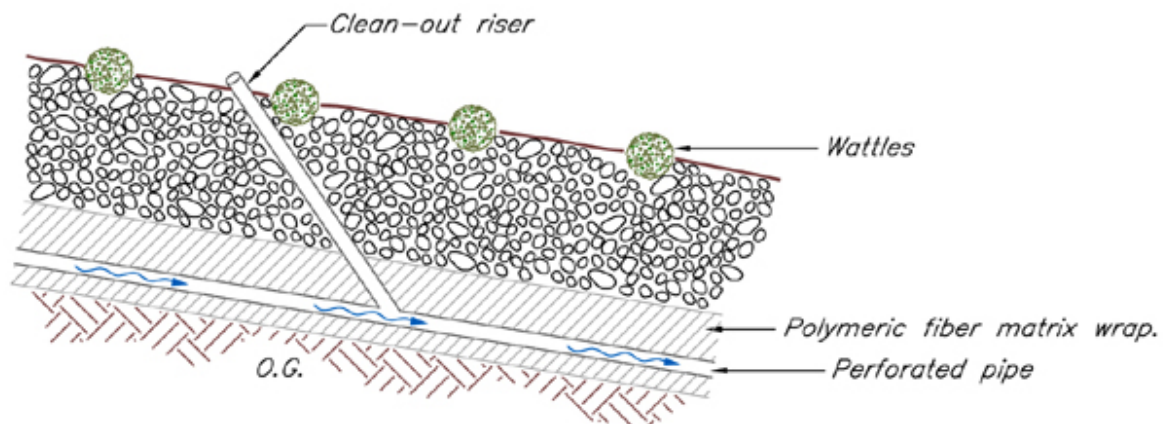
- The exit end of the subsurface drain shall be checked periodically to insure that water is flowing out of the drain.
- The subsurface drain pipe shall be flushed via the clean-out access tube as-needed if inspection indicates that the drain may be clogged. Flushed materials typically consist of excess groundwater and shall be disposed of properly based on site specific conditions and local requirements.

Common Failures: The most common reasons for failure are improper design of the interceptor drain placed at the bottom of the axial trench. The perforated pipe shall be correctly sized and wrapped with a suitable geodrain composite that excludes fines but that lets water through. Failure to inspect and flush the drain via the clean-out access tube, as needed, can lead to prolonged clogging and poor performance.

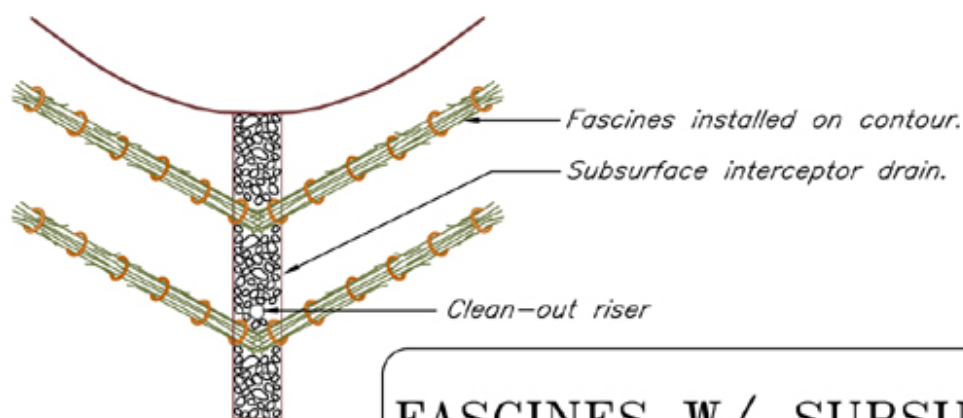
Another frequent cause of failure is poor maintenance.



CROSS-SECTION OF SUBSURFACE INTERCEPTOR DRAIN



SLOPE CROSS-SECTION

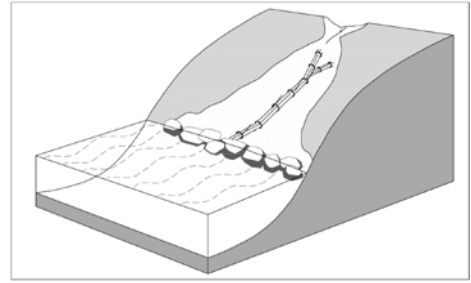


PLAN VIEW

FASCINES W/ SUBSURFACE INTERCEPTOR DRAIN

LIVE POLE DRAINS – EP-19

Application: Live pole drains are drainage systems composed of bundles of live willow (*Salix* spp.) branches (live fascines or willow wattles) placed in areas where excess soil moisture results in soil instability. They are intended to drain excess water away from an unstable bank. The BMP is one of several biotechnical erosion control (also known as soil bioengineering) techniques to arrest and prevent slope failures and erosion; also used to enhance wildlife habitat and be aesthetically pleasing because the willows are expected to sprout and grow.



Design Guidelines: Live pole drains are most applicable on streambanks and slopes where excessive soil moisture is causing piping, erosion, or slumping gullies. Live pole drains tend to be used most frequently on outer bends.

When designing a project, one must decide whether to use willow wattles or live fascines. Both are constructed of the same size poles, and in the same manner, with the exception of the orientation of the cuttings. Fascines have all the cuttings oriented one way (all butt ends together), while wattles are composed of poles oriented in both directions.

The use of live fascines will facilitate rooting, as cuttings grow best when the tips are pointed uphill. The use of willow wattles, on the other hand, will provide more efficient drainage, as half of the tapering tips are pointed downward, but rooting success will likely be lower. Therefore, one must decide whether the goal of the project is drainage or plant establishment.

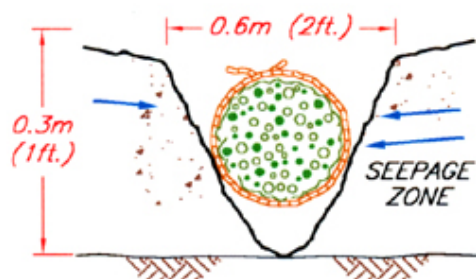
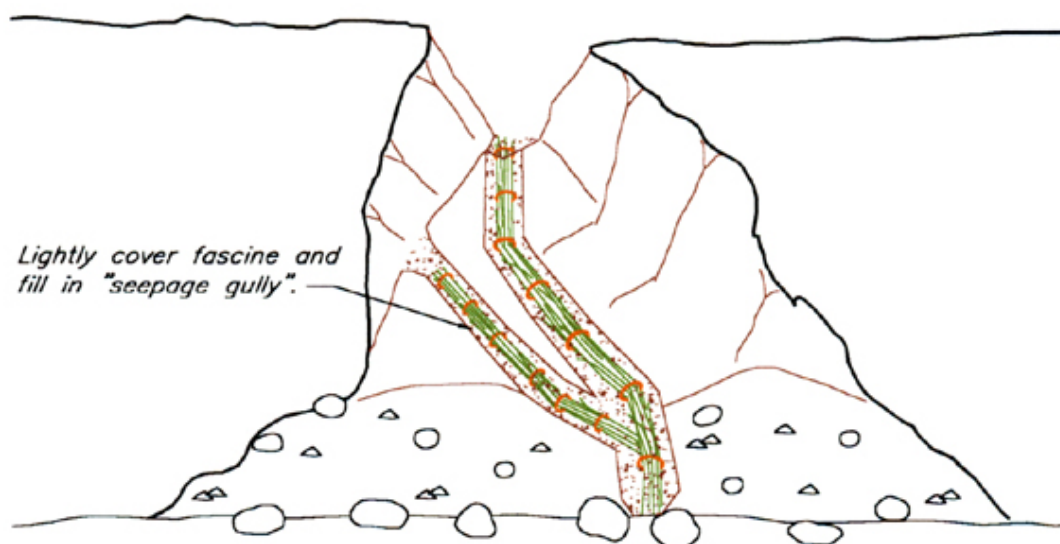
Materials/Equipment: Live Pole Drains are essentially willow wattles or fascines constructed with longer than usual poles, with many of the branches left on, and staked with live willow stakes, construction stakes, or a combination of the two. Stakes must not be allowed to dry out. All cuttings shall be soaked in water for 5-7 days (a minimum of 24 hours) and planted the same day they are removed from the water.

Construction Specifications/Installation:

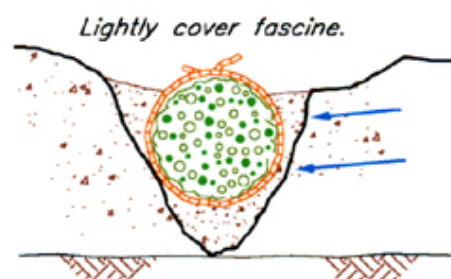
- Place the wattles or fascines in an excavated trench or existing drainage gully in an area of seepage, such that they intercept and control excess moisture on the bank.
- Key the bundles into each other by jamming the ends together firmly and stake into place with live or inert stakes at 3-6 foot intervals.
- Stakes shall be placed near rope ties and in transitional areas for additional support.

Monitoring/Maintenance: Regular inspection and maintenance of wattle installations shall be conducted, particularly during the first year, and repairs shall be made promptly. Any stakes that loosen because of saturation of the slope or frost action shall be re-installed. Rills and gullies around or under wattles shall be repaired using Brush Packing or Live Gully Fill Repair (EP-20), as necessary. All temporary and permanent erosion and sediment control practices shall be maintained and repaired to assure continued performance of their intended function.

Common Failures: Inappropriately using a subsurface drainage technique—Live Pole Drains—when a surface runoff control measure is necessary. Another frequent cause of failure is poor maintenance.



Excavate a shallow trench or utilize existing "seepage gully" (small < 2ft.²).



Place bundle of cuttings (fascine) in the trench and lightly backfill with native material.

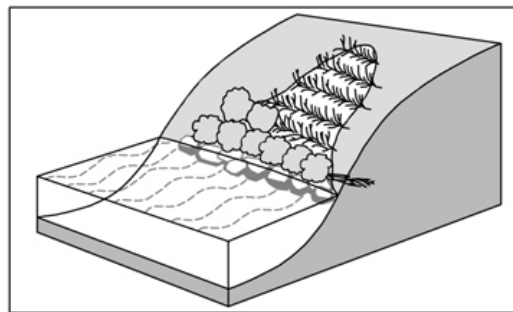
NOTES:

1. Live pole drain is a biotechnical technique which drains excess moisture from the bank and provides an initial cover of woody vegetation.
2. The cuttings used to form the fascines are intended to sprout and grow while the excess moisture continues to drain from the lower end.

LIVE POLE DRAIN

BRUSH PACKING OR LIVE GULLY FILL REPAIR – EP-20

Application: In general, Brush Packing or Live Gully Fill Repair consists of a combination of techniques for stabilizing eroding intermittent or ephemeral channels. These repair techniques taken together include grading, installing drainage and fill, live cuttings, and surface erosion control. Brush Packing or Live Gully Fill Repair (also called brushlayering) consists of alternating layers of live branch cuttings and compacted soil. This reinforced fill can be used to repair small gullies. The method is similar to branch packing (a method for filling small holes and depressions in a slope), but is more suitable for filling and repairing elongated voids in a slope, such as gullies. The BMP is one of several biotechnical erosion control (also known as soil bioengineering) techniques to arrest and prevent slope failures and erosion; also used to enhance wildlife habitat and be aesthetically pleasing.



Design Guidelines:

- Live Gully Fill Repair is useful for gullies up to 1-6 feet in depth and up to 30 feet long.
- This repair technique shall only be used in channels with intermittent flows. The erosion processes at work in the incised channel or gully, must be correctly identified and understood to make a successful repair.

This technique is used to fill small gullies in natural slopes and streambanks.

- Fill placed in the channel shall consist of graded and well drained soil.
- Imbedded branches and their secondary roots will reinforce the backfill used to repair the gully and protect it against future washout and scour.
- A subsurface drain may be required if significant amounts of seepage or groundwater enters the gully at its head.
- Surface runoff entering the gully at its head shall be intercepted and diverted away from the area utilizing runoff controls such as pipe slope drains (RC-1), diversions (RC-3 and RC-4), or grass-lined channels (RC-5).

Gully treatment must include correcting or eliminating the initial cause of the gully as well as the gully itself. Accordingly, consideration shall be given to diverting excessive or concentrated runoff away from the gully head area. There may be side gullies that also require treatment; however, priority shall be given to the main channel.

Materials/Equipment:

- Graded and well drained soil for use as fill material.
- Live branch cuttings ranging from ½ to 2 inches in diameter.
- The branches shall be long enough to touch the undisturbed soil at the bottom (back) of the gully and to protrude slightly beyond the rebuilt slope face.

Construction Specifications/Installation: Live gully fill repair begins at the lowest point in the gully and proceeds upward. The live branches are inserted between successive lifts of lightly compacted soil. The following guidelines and procedures are recommended when installing a live gully fill repair system:

- Starting at the lowest point of the slope, place a 3-4 inch layer of branches at the lowest end of the gully and approximately perpendicular to the gully bottom (see Figure EP-20.1).

- Cover with a 6-8 inch thick of fill soil and compact
- Place the live branches in a crisscross fashion. Orient the growing tips toward the slope face with the basal ends lower than the growing tips.
- Follow each layer of branches with a layer of soil; work and compact the soil to ensure intimate contact with the branches and to eliminate large voids in the fill.

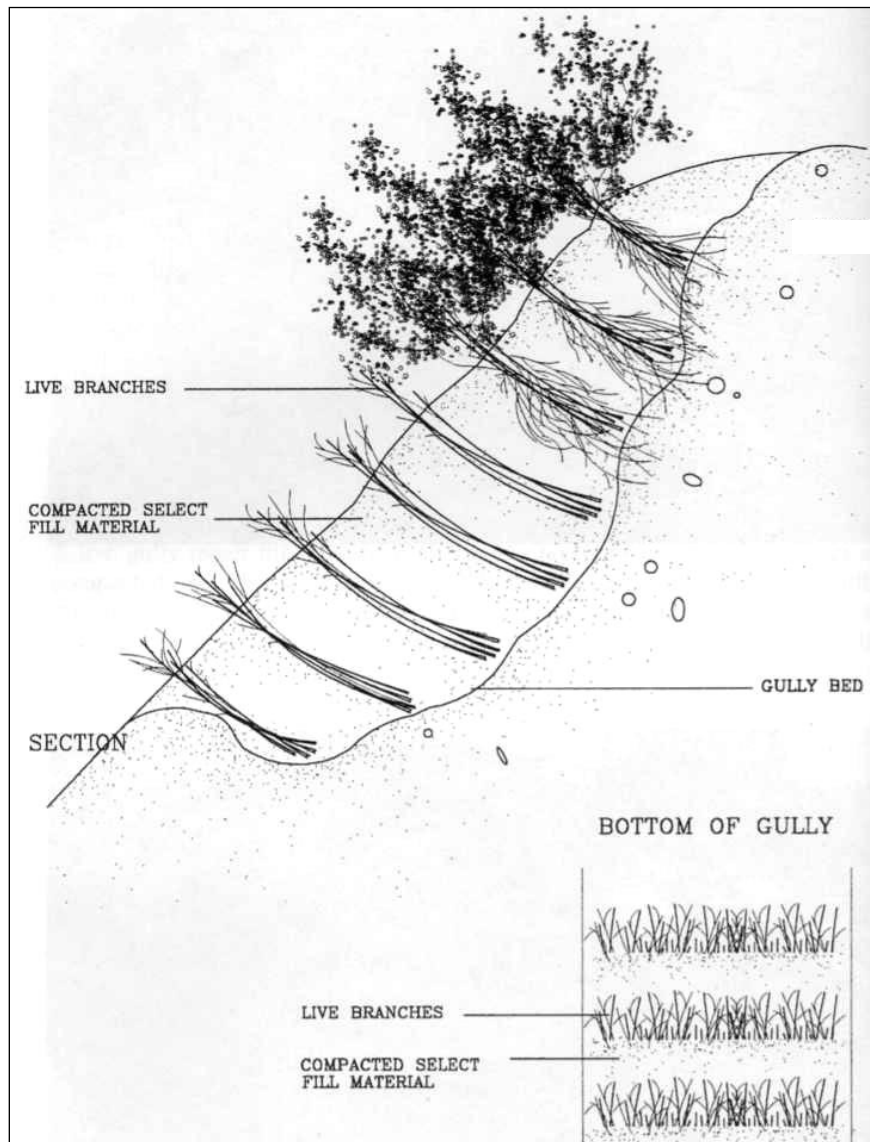
Monitoring/Maintenance:

- Periodically check on stability of the fill within the repaired gully, particularly during the initial vegetative establishment period.
- Check for wet spots or seeps in the fill which indicate subsurface seepage problems. Examine the surface of the fill for evidence of runoff erosion such as rills.
- Make sure that runoff is diverted away from the fill during initial stages.

Common Failures: The main reason for failure of Brush Packing or Live Gully Fill Repair is saturation and washout of the earthen fill. Prevention of this outcome requires that seepage and runoff be excluded as much as possible from the fill area.

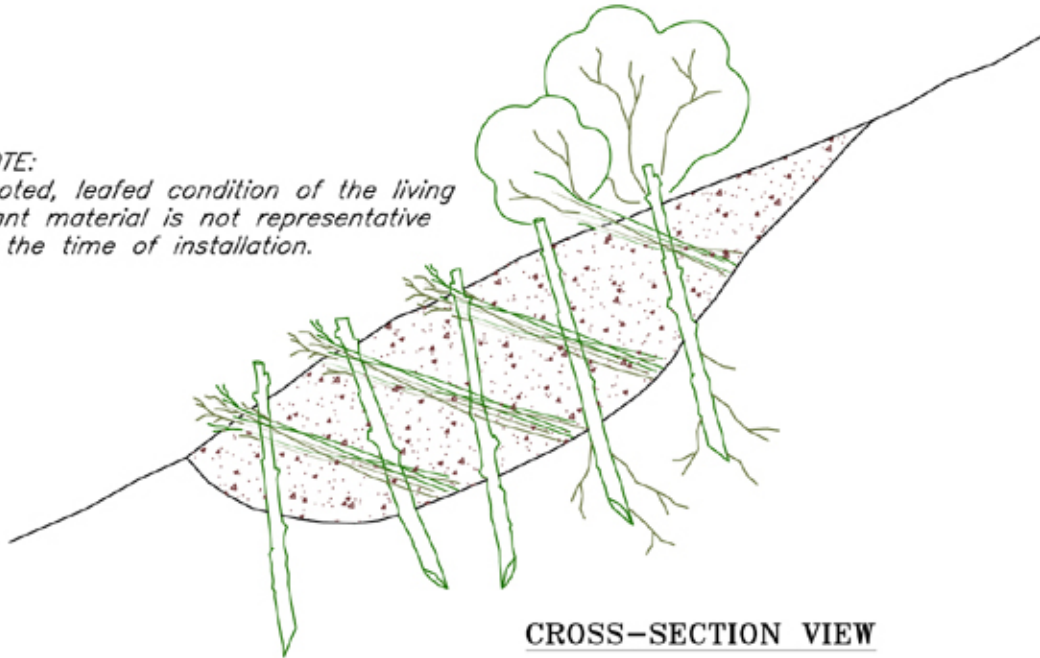
Another frequent cause of failure is poor maintenance.

FIGURE EP-20.1. ESTABLISHED LIVE GULLY FILL REPAIR.



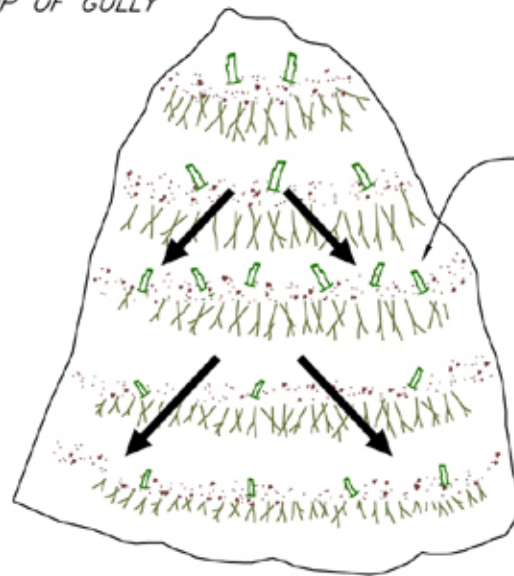
NOTE:

Rooted, leafed condition of the living plant material is not representative of the time of installation.



CROSS-SECTION VIEW

TOP OF GULLY



Successful live gully repair requires that the gully be filled convex such that runoff drains away from the center.

BOTTOM OF GULLY/SLUMP

PLAN VIEW

LIVE GULLY FILL REPAIR

SODDING – EP-21

Application: Sodding is the placement of permanent grass cover that has been grown elsewhere and brought to the site. Sodding stabilizes an area by immediately covering the soil surface with “sheets” of pre-established grass, thereby protecting the soil from erosion, enhancing infiltration, filtering sediment and other pollutants, and slowing runoff velocities.

Design Guidelines: Sodding is appropriate for areas that contained turf or grasses before construction; any graded or cleared area that might erode; and areas where a permanent, long lived plant cover is needed immediately. Sodding may be used in vegetative buffer zones, stream banks, grassed dikes, swales, slopes, outlets, level spreaders, and filter strips and is particularly effective on flood plains, areas adjacent to wetlands or other sensitive water bodies, and on steep, unstable slopes. Natural revegetation may be more appropriate for areas not prone to erosion and where there is an available seed source.

Materials/Equipment: Sod shall be healthy and field grown, containing thatch not more than 1/2-inch thick. The age of the sod shall be between 8 and 16 months old. The sod shall be free from disease, weeds, insects, and undesirable types of grasses and clovers and grown in accordance with any applicable agricultural requirements. Soil upon which the sod was grown shall contain less than 50% silt and clay. Sod shall be machine cut at a uniform soil thickness of 0.625 inches \pm 0.25-inch, excluding top growth and thatch. A certificate of compliance for the sod shall be furnished to the contractor.

Construction Specifications/Installation:

- Sod shall be protected with tarps or other protective covers during delivery and shall not be allowed to dry out between harvesting and placement.
- All weeds and debris shall be removed before cultivation of the area to be planted and properly disposed.
- After cultivation, installation of irrigation systems, and rough grading are completed, areas to be planted with sod shall be fine graded and rolled. Topsoil may be needed in areas where the soil type and texture are inadequate. Areas to be planted with sod shall be smooth and uniform before placing sod. Areas to be planted with sod adjacent to sidewalks, concrete headers, header boards, and other paved border and surface areas shall be 1.5 inches \pm 0.25-inch below the top grade of such facilities after fine grading, rolling, and settlement of the soil. Sod shall be placed so that ends of adjacent strips of sod are staggered at least 24 inches. All edges and ends of sod shall be placed firmly against adjacent sod and against sidewalks, concrete headers, header boards, and other paved borders and surfaced areas.
- After placement of the sod, the entire sodded area shall be lightly rolled to eliminate air pockets and ensure close contact with the soil. After rolling, the sodded areas shall be watered so the soil is moistened to a minimum depth of 4 inches. Sod shall not be allowed to dry out, planted during very hot or wet weather, or placed on slopes that are greater than 3H:1V if they are to be mowed.
- If irregular or uneven areas appear before or during the plant establishment period, such areas shall be restored to a smooth and even appearance.
- The sod (turf) shall be allowed to grow to 3 inches high. When the turf reaches this height, it shall be mowed to a height of 1 inch or as recommended by the grower of the sod. All turf edges—including edges adjacent to sidewalks, concrete headers, header boards, and other paved borders and surfaced areas—shall be trimmed to uniform edge not extending beyond the edge of turf or such facilities.
- Mowed and trimmed growth shall be removed and disposed of outside the project. Trimming shall be repeated whenever the height of the turf exceeds 1 inch.

Monitoring/Maintenance:

- Inspect sod installations weekly and after significant storm events, until the turf is established.

- Maintenance shall consist of mowing, weeding, and ensuring that the irrigation system is operating properly and as designed to sustain growth.

Common Failures:

- Insufficient moisture, or temperature that is too hot or cold.
- Improper site preparation.
- Poor sod quality.

SOIL STOCKPILE MANAGEMENT – EP-22

Application: Soil stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from temporary stockpiles of soil, which are susceptible because slopes may be steep and soil may be recently disturbed. For topsoil stockpiles, see EP-4.

Design Guidelines: Locate temporary stockpiles at least 50 feet away from inlets, drainage courses, or water bodies. Stockpiles shall be seeded for vegetation or covered with plastic sheeting.

Materials/Equipment: Earthmoving equipment, temporary erosion control seed mix, plastic sheeting, tape, stakes, weights (anchors), and rope.

Construction Specifications/Installation:

- Limit soil stockpile height to 15 feet, unless City approves taller stockpile.
- Perimeter sediment control (e.g., berm, sediment fence, fiber rolls, or gravel bags) at the toe of slope shall be installed at soil stockpiles year round.
- Protect storm drain inlets, drainage courses, and receiving waters from soil stockpile erosion, using drain inlet protection and perimeter sediment controls, as appropriate.
- Implement dust control practices, as appropriate, to prevent wind erosion of stockpiled soil material.

Vegetation Cover:

- At the onset of inactivity or upon completion of final grading, apply temporary seeding within 14 days during the wet season (October 1st through May 31st) or within 30 days during the dry season (June 1st through September 30th).
- Follow additional seeding specifications in Temporary Seeding and Planting (EP-5).

Plastic Sheeting Cover:

- Avoid using plastic sheeting on soil stockpiles located above steep or unstable slopes that may be adversely affected by concentrated runoff.
- Use 6-millimeter plastic or comparable material. Overlap seams 1-2 feet. Tape, roll, and stake the seams.
- Weigh down the entire length of plastic. Anchor the plastic using sandbags or other suitable tethered anchoring system spaced on 10-foot grid spacing.

Additional Measures for Steep Slope Protection:

- When possible, install a diversion dike (RC-4) at the top of the plastic to divert flows away from the slope.
- Toe-in the top of the plastic sheeting in a 6-inch x 6-inch trench, backfilled with compacted native material.
- Install augmented perimeter sediment control (e.g., gravel berm, riprap, or other suitable protection) at the toe of the slope to dissipate runoff velocity.

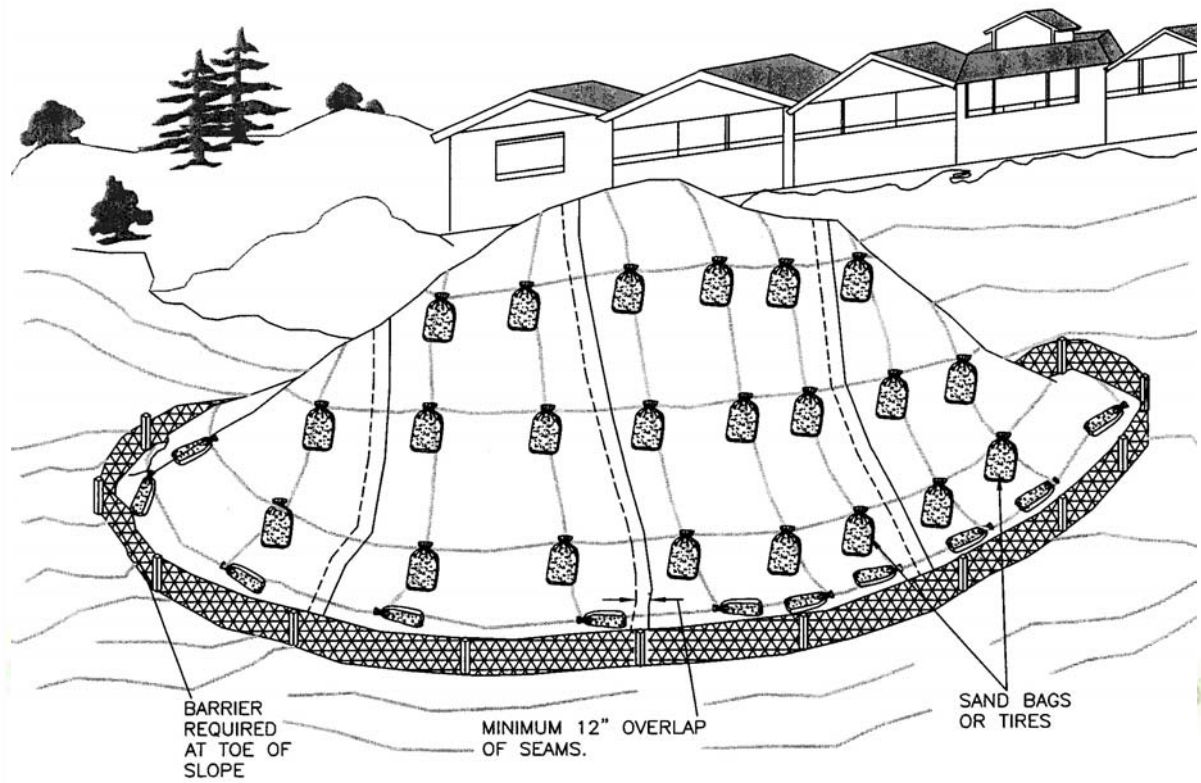
Monitoring/Maintenance:

- Inspect stockpiles regularly, and prior to and after storm events.
- Repair rills and gullies of vegetated stockpiles.
- Check plastic anchoring system and repair or add anchors, as needed.

- Replace torn sheeting and repair open seams.
- Completely remove plastic after it is no longer needed.

Common Failures:

- Seeded too late for germination before cold weather.
- Poorly installed plastic sheeting and anchor system.
- Erosion hazard due to water sheet flowing off plastic at high velocity.
- Lack of maintenance.



PLASTIC SHEETING

NOTES:

1. MINIMUM 12" OVERLAP OF ALL SEAMS REQUIRED.
2. BARRIER REQUIRED @ TOE OF STOCK PILE.
3. COVERING MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10' GRID SPACING IN ALL DIRECTIONS.

SOIL STOCKPILE MANAGEMENT WITH
PLASTIC SHEETING

EP-22

EPSC Details For Runoff Control

SLOPE DRAIN – RC-1

Application: Slope drains (and subsurface drains) are used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Also refer to BMP EP-19, Live Pole Drains.

Design Guidelines: Slope drains are constructed with pipes or lined channels that convey surface runoff down slopes without causing erosion.

Materials/Equipment:

Slope Drains are constructed from flexible down drain, plastic pipe, or sewn filter fabric, and are used to direct concentrated flows down slopes without causing erosion to exposed or stabilized slopes.

Subsurface drains are constructed from tile, pipe, or tubing and are used to improve drainage and stabilize slopes in areas with saturated soils.

Construction Specifications/Installation:

- Place slope drains on undisturbed soil or well-compacted fill at locations and elevations shown on plans.
- Slightly slope the section of pipe under the dike toward its outlet.
- Compact the soil under and around the entrance section in lifts not to exceed 6 inches.
- Ensure that fill over the drain at the top of the slope has a minimum depth of 1.5 feet and a minimum top width of 4 feet. The sides should have a 3H:1V slope.
- Ensure that all slope drain connections are watertight.
- Ensure that all fill material is well-compacted. Securely fasten the exposed section of the drain with grommets or stakes spaced no more than 10 feet apart. If the drain is longer than 10 feet, the drain must be anchored within each 10 foot section and at the end section. Anchoring methods can vary depending on site conditions. At a minimum, the drain shall be staked such that it is not able to move laterally or separate from the upstream diversion culvert.
- Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion (see RC-2, Energy Dissipater/Outlet Protection).
- Make the settled, compacted dike ridge no less than 1 foot higher than the top of the pipe inlet.
- Immediately after grading, stabilize all disturbed areas as appropriate (see Erosion Prevention BMPs).

Monitoring/Maintenance: Inspect the slope drain and supporting diversions before, during, and after every storm event and promptly make necessary repairs. When the protected area has been permanently stabilized, remove the temporary measures, dispose of the materials properly, and stabilize disturbed areas appropriately.

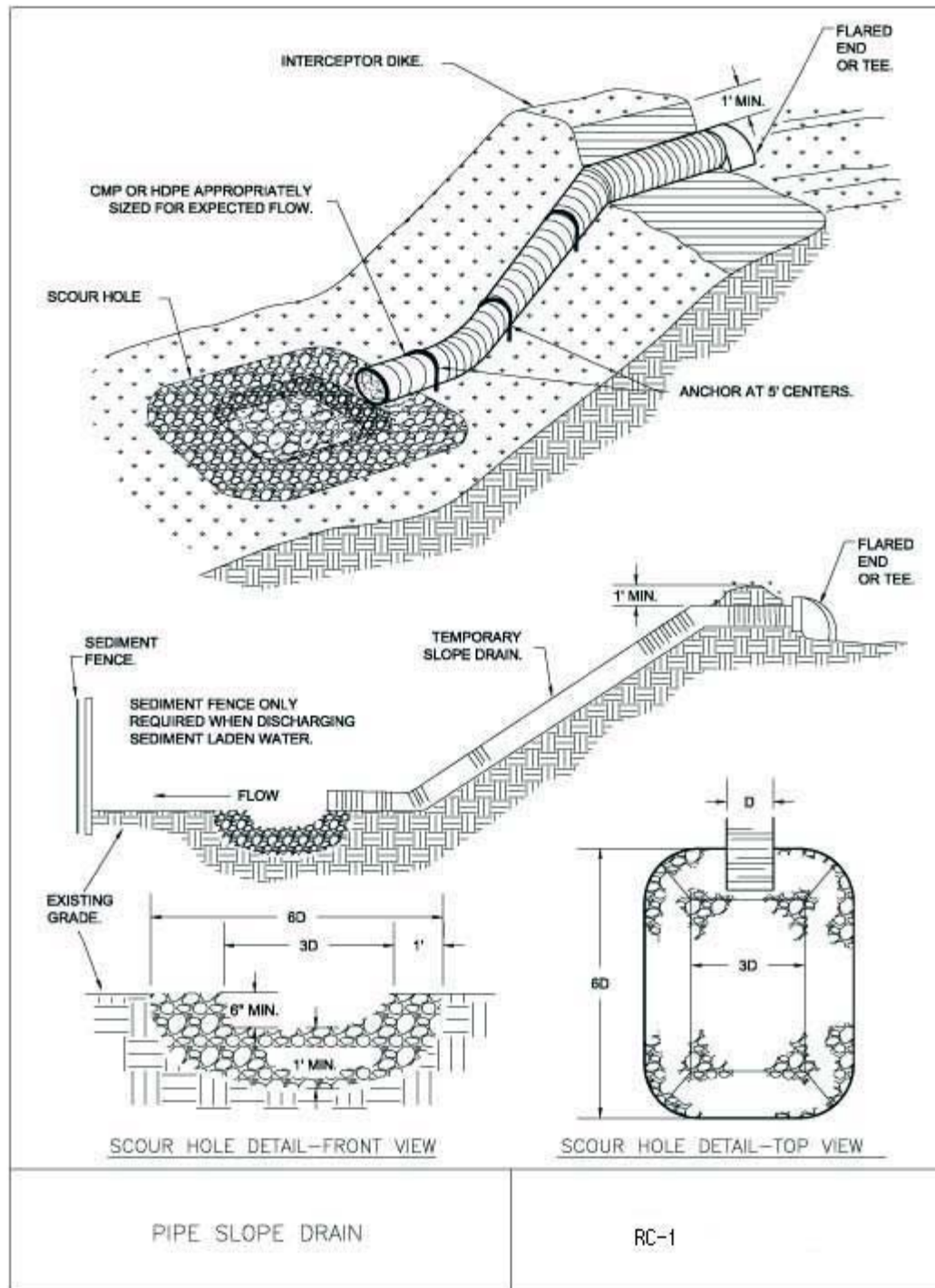
Common Failure: Caused by water saturating the soil and seeping along the pipe. Reduce potential failure by properly backfilling around and under the pipe haunches with stable soil material and hand compacting in 6-inch lifts to achieve firm contact between the pipe and the soil at all points.

Alternative: As an alternative to slope drains, visqueen flume down drains may be used to convey runoff to a stabilized downstream conveyance. The visqueen shall be anchored at the top of a slope similar to erosion control blankets (EP-10). Use sandbags to stabilize the sides of the visqueen flume similar to sand bag barriers (SC-2). The visqueen (plastic sheet) shall meet the following specifications:

- Plastic sheeting shall have a minimum thickness of 6 mil, and shall be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 feet apart. Seams shall

overlap at least 12 to 24 inches and taped or weighted down their entire length. Edges shall be embedded a minimum of 6 inches in the soil.

- After installation all sheeting shall be inspected periodically and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures shall be repaired immediately. If washout or breakages occur, the material shall be reinstalled after repairing the damage to the slope.



ENERGY DISSIPATER/OUTLET PROTECTION – RC-2

Application: Velocity dissipation and outlet protection devices are physical structures such as rock riprap, stone, or concrete flow spreaders placed at the outlet of drainage culverts and channels to reduce the velocity and/or energy of the exiting water.

Design Guidelines: This BMP provides specifications for riprap type energy dissipaters. Alternative energy dissipation methods such as mats, plates, or other stabilization techniques may be used in the project Erosion Prevention and Sediment Control Plan as approved by the City.

Materials/Equipment:

- Riprap may be field stone or rough quarry stone. It shall be hard, angular, highly weather-resistant and well graded. Riprap size to be determined by project engineer and must meet City specification requirements.

Construction Specifications/Installation:

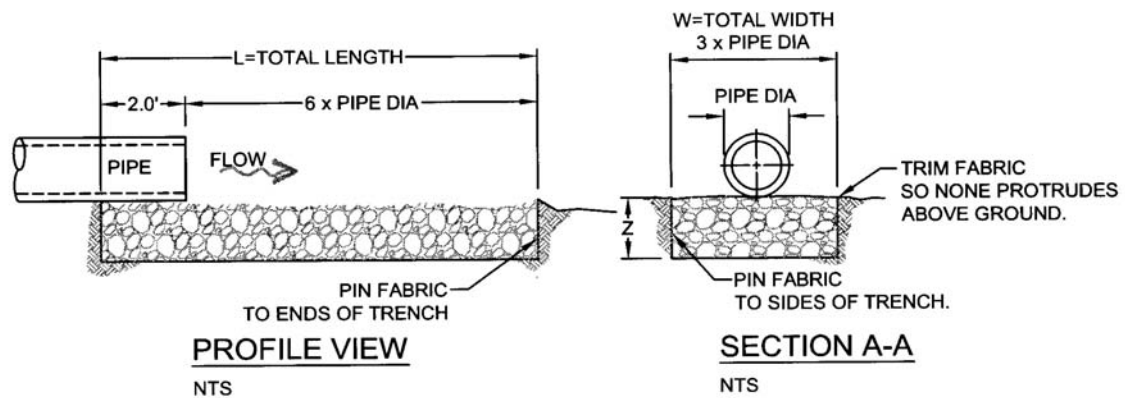
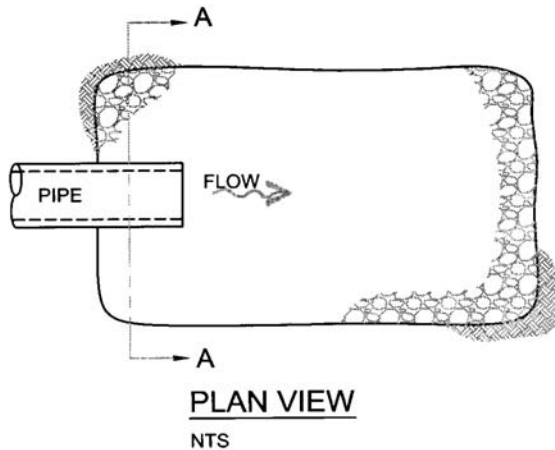
- Ensure that the subgrade for the filter and riprap follows the required lines and grades shown on the plans. Compact any fill required in the subgrade to the density of the surrounding undisturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.
- The riprap and gravel filter must conform to the specified grading limits shown on the plans.
- Filter fabric, when used, must meet design requirements and be properly protected from punching or tearing during installation. Repair any damaged fabric by removing the riprap and placing another piece of filter fabric over the damaged area. All connecting joints shall overlap a minimum of 1 foot. If the damage is extensive, replace the entire filter cloth.
- Riprap may be placed by equipment, but take care to avoid damaging the fabric.
- The minimum thickness of the riprap shall be 1.5 times the maximum stone diameter.
- Construct the apron on a zero grade with no overflow at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.
- Ensure that the apron is properly aligned with the receiving stream and preferably straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of the apron.
- Immediately after construction, stabilize all disturbed areas with vegetation.
- Outlets of all water conveyances must be stabilized.

Monitoring/Maintenance:

- Inspect riprap outlet structures before, during, and after rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.
- Clean out energy dissipation as necessary when approximately half of the void space is filled with sediment and debris.

Common Failures:

- Tearing filter fabric during installation.



ROCK SIZE-CLASS	Z TRENCH DEPTH RANGE	TYPE OF FABRIC (NON-WOVEN OR WOVEN)
25 Lb	10"-16"	NW OR W
75 Lb	1.0'-1.5'	NW OR W
200 Lb	1.5'-2.0'	W
1/4 TON	2.5'-3.0'	W
1/2 TON	3.0'-4.0'	W
1 TON	4.0'-5.0'	W

**ENERGY DISSIPATER/OUTLET
PROTECTION**

RC-2

TEMPORARY DIVERSION SWALE – RC-3

Application: A diversion swale is a small excavated channel lined with grass, matting, or riprap. Swales are used to convey runoff down sloping land or divert runoff away from a sensitive area or steep slope to avoid erosion. These structures can be used to direct runoff to a stabilized outlet, watercourse, drainage pipe, channel, or sediment-trapping device.

Alternative: Alternatives to Diversion Swale techniques are Slope Drains (RC-1), Temporary Diversion Dikes (RC-4), and Grass-Lined Channels (RC-5).

Design Guidelines: Diversion swales intercept, divert, and convey surface run-on—generally sheet flow—to prevent erosion and transport of pollutants through and from the site. Construct diversion swales to intercept and divert run-on to avoid sheetflow over sloped surfaces and work areas.

Materials/Equipment: Excavation equipment and seed, riprap, or matting. Check dams (RC-11) shall be installed as necessary to reduce velocity.

Construction Specifications/Installation:

- Construct diversion swale to adequately divert storm flows based on careful evaluation of the risks due to erosion of the measure, soil types, over topping, flow backups, washout, and drainage flow patterns for each project site.
- Soil stabilization (e.g., vegetation (EP-5 and EP-6), blankets (EP-10), riprap) is required to prevent scour in the swale. Additional velocity controls (e.g., check dams) may be necessary.
- Correctly size and locate swales. See Table RC-3.1. Excessively steep, unlined dikes and swales are subject to erosion and gully formation.

TABLE RC-3.1. TEMPORARY DIVERSION SWALE DESIGN CRITERIA		
Bottom Width	24-inch minimum, level bottom	
Depth	12-inch minimum	
Side Slopes	Less than 2H:1V	
Slope Grade	5% maximum with positive grade to suitable outlet	
Slope of Disturbed Area vs. Horizontal Spacing	< 5%	300 feet
	5 to 10%	200 feet
	10 to 25%	100 feet
	25 to 50%	50 feet
Slope Stabilization	Vegetation, matting, or 12 inches of riprap pressed into bank 3-4 inches	
Outlet	Level spreader or riprap to stabilized outlet or sediment pond	

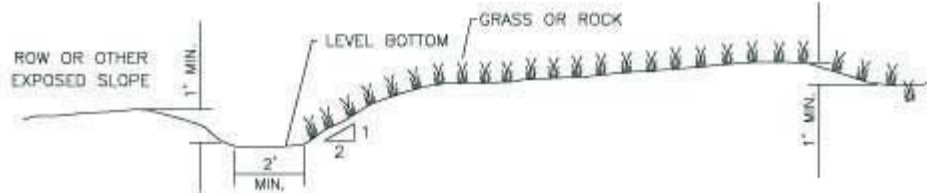
- The swale shall have a level 2-foot-wide bottom with side slopes no greater than 2H:1V.
- The grade shall not exceed 5 percent with a positive drainage to a stabilized or suitable outlet.
- Divert runoff to an appropriate downstream location. Do not divert runoff to adjacent properties without permission.

- Use flow spreaders to convert concentrated runoff into sheetflow prior to discharge onto areas stabilized by existing vegetation and intermittently throughout the swale.
- Install swales early in the construction process. Utilize permanent systems when applicable.
- Convey collected run-on/concentrated flows down slopes in accordance with the RC-1, Slope Drains.
- Provide stabilized outlets. Refer to Energy Dissipater/Outlet Protection (RC-2).

Monitoring/Maintenance:

- Inspect swales regularly for erosion, debris, and sediment; and before, during, and after rain events. Repair as necessary.
- Temporary conveyances shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

Common Failure: Diverting runoff without providing soil stabilization, velocity, and sediment controls.



BOTTOM WIDTH	2 FEET MINIMUM; THE BOTTOM WIDTH SHALL BE LEVEL
DEPTH	1 FOOT MINIMUM
SIDE SLOPE	2H:1V OR FLATTER
GRADE	MAXIMUM 5 PERCENT, WITH POSITIVE DRAINAGE TO A SUITABLE OUTLET (SUCH AS SEDIMENTATION POND)

DIVERSION SWALE



TEMPORARY DIVERSION DIKE

Slope	Spacing
<5%	300 feet
5-10%	200 feet
10-40%	100 feet

NOTE:
IMMEDIATELY UPON CONSTRUCTION,
ESTABLISHED VEGETATION OR EROSION
CONTROL BLANKETS ARE REQUIRED.

DIVERSION DIKE / SWALE

RC-3 and RC-4

TEMPORARY DIVERSION DIKE – RC-4

Application: A temporary diversion dike is a low berm or ridge of compacted soil that channels water away from a steep slope or embankment and toward a desired location. The purpose of a diversion is to intercept and divert runoff away from the face of a steep slope or streambank.

Design Guidelines: Diverted runoff shall outlet onto a stabilized area, a prepared level spreader, or into a slope protection structure, e.g., a slope drain. Diversion dikes are constructed from compacted earthen fill and shall be used on drainage areas of 5 acres or less. In addition to protecting the face of a steep slope from overbank runoff, diversions may also improve general slope stability by preventing runoff from infiltrating into and saturating the face of the bank. Earth dikes shall be stabilized with vegetation.

Materials/Equipment: Construction of a low dike requires soil with sufficient fines to hold a 2H:1V side slope and to be relatively impermeable when compacted. The dike can be constructed by hand or with the aid of a backhoe or front-end loader.

Construction Specifications/Installation:

- Diversion dikes are constructed from compacted earthen fill to a height of 18 inches with side slopes 2H:1V or flatter. Height is measured from the upslope toe to the top of the dike. See Table RC-4.1 for design criteria.
- The dike shall have a minimum top width of 2 feet. A shallow trench or swale to contain the diverted runoff is normally incorporated into the design. Soil from the ditch shall be used to construct the berm, provided it has sufficient fines to hold a 2H:1V side slope and be relatively impermeable when compacted. The swale or drainage ditch must have positive drainage to an outlet. Vegetative or mechanical stabilization may be required where grades are excessive.
- If overbank runoff is a problem, construction of a diversion dike or interceptor shall precede other bank stabilization treatments.
- The height of the dike shall be kept below 18 inches so as not to interfere with bank access.
- Use of a ditch and bank combination allows more efficient capture and diversion of runoff.
- Soil excavated from the ditch can be used to construct the dike. Slope drains shall be inserted through the dike periodically to convey the collected runoff to an appropriate discharge point.
- The ditch shall be constructed with sufficient positive grade for discharge to an appropriate outlet.
- The Temporary Diversion Swale BMP (RC-3) can be used as an alternative design for RC-4.
- The BMP detail for RC-4 is provided with BMP RC-3.

Monitoring/Maintenance:

- The dike and/or berm shall be inspected to ensure that it has not been breached. Repair as needed or as directed. The swale behind the dike also shall be inspected for accumulation of sediment and debris. Excessive sediment accumulations shall be removed.

Common Failures:

- Overtopping and/or breaching of the dike or berm.
- Excessive sediment accumulation in the ditch or swale behind the berm.
- Inadequate or insufficient outlet capacity of any appurtenant drop inlet and/or slope drains.

TABLE RC-4.1. TEMPORARY DIVERSION DIKE DESIGN CRITERIA		
Top Width	24-inch minimum	
Height	12-inch minimum measured from upslope toe and at a 90% standard proctor compaction ASTM D698	
Side Slopes	Less than 2H:1V	
Slope Grade	Topography dependent	
Dike Grade	Between 0.1 and 1%	
Slope of Disturbed Area vs. Horizontal Spacing	< 5%	300 feet
	5 to 10%	200 feet
	10 to 25%	100 feet
	25 to 50%	50 feet
Slope Stabilization	< 5%: Seed and mulch within 5 days following dike construction	
	5 to 40%: Stabilize immediately sod, matting with seed, or riprap	
Outlet	Upslope side of dike provides positive drainage to the outlet. Provide energy dissipation as necessary to prevent erosion. Release sediment-laden runoff to a sediment-trapping facility.	

GRASS-LINED CHANNEL (TURF REINFORCEMENT MATS) – RC-5

Application: Turf Reinforcement Mats (TRMs) are designed to provide protection to resist channel and streambank erosion and are useful when channel soils may subside or shift after installation. Installation of grass-lined channels with TRMs is typically part of the permanent drainage design for a site or could be a temporary control for a long-duration construction project.

Design Guidelines: TRMs can be installed after applying seed to the prepared soil surface or deployed first, and then seeded following infilling with soil. The former method allows the roots and shoots to grow through and interlock with the geosynthetic matrix. The channel or bank surface requires careful preparation, must be uniform and relatively free of rocks, stumps, and clods to ensure that there is complete contact between the TRM and the soil surface.

Materials/Equipment: TRMs are similar to Erosion Control Blankets, but they usually are intended for lining channels (see EP-10 for slope installation techniques). They are composed of ultraviolet (UV) stabilized polymeric fibers, filaments, nettings and/or wire mesh, integrated together to form a three-dimensional matrix $\frac{1}{4}$ to $\frac{3}{4}$ in thick. The types of polymer include polypropylene, polyethylene, polyamides, and polyvinyl chloride. TRMs are often combined with organic material such as coir to aide vegetation establishment and provide the initial temporary erosion control necessary to resist erosion due to rain impact and runoff until the vegetation can become established. Typical vegetation includes grasses that can withstand inundation. TRMs may be installed either by hand labor or equipment; the main tools or equipment required consist of hammers, stapling devices, and shovels or equipment for trenching.

Construction Specifications/Installation: Select a type of TRM based on the site condition and shear stress, as shown in Table RC-5.1 below.

The number of anchoring stakes or staples per foot is site and product specific, and shall be determined according to the manufacturer's specifications. See Table RC-5.2 below for stake sizing recommendations. Live willow stakes may be substituted for metal or wooden anchoring stakes, although it should be noted that willows could shade out turf grass. Willow wattles or fascines may be used to anchor the mats into the slots.

TABLE RC-5.1. RECOMMENDATIONS FOR TRM APPLICATIONS (Erosion Control Technology Council, 2001)

Type	UV Stability Minimum tensile strength retained after 1000 hr. (ASTM D 4355) (%)	Tensile Strength ^{1,2} (ECTC ⁴ mod. ASTM D5035) lb/ft	Application	
			Slope	Channel
			H:V	max. shear stress ³ (ASTM D6460 or other ECTC approved tests) lb/ft ²
A	80	125	1:1	6
B	80	150	0.5:1	8
C	80	175	0.5:1	10

¹ Minimum average roll values, machine direction.

² Field conditions with high loading and/or high survivability requirement may warrant the use of TRMs with tensile strength of 3000 lb/ft or greater

³ Max. shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion during a 30-minute flow event. (Note: fully vegetated shear stress properties for TRMs containing degradable components must be obtained on the non-degradable portion of the matting alone.)

⁴ Erosion Control Technology Council – *Technical Guidance Manual for Testing Rolled Erosion Control Products*.

TABLE RC-5.2. RECOMMENDATIONS FOR TRM STAKE SELECTION

Stake Length	Soil Conditions
6 inches	Typical soil conditions. Six-inch staples used in all but loose soil types.
8 inches	Loam, relatively loose sandy loam to sandy soils. Eight-inch staples are typically used in high velocity channel applications.
> 12 inches	Excessively loose soils, slopes containing fine silt, sand, or soft mud. Deep and soft fills, loose sands, silts, loams or "quick" conditions. Staples 12 inches and longer are used in shoreline applications in which wave action is a factor or in instances where soils remain saturated for long periods of time.

Site Preparation. The site shall be fine graded to a smooth profile and relatively free from all weeds, clods, stones, roots, sticks, rills, gullies, crusting and caking. Fill any voids and make sure that the channel is compacted properly.

Seeding. Seed may be applied prior or after the installation of the TRM. Select a native seed mix adapted to the local area and soil conditions. Choosing the appropriate seed mix will ensure optimum germination, root system development, vegetation density, and long term functionality. The types of seeds planted above the anticipated water line may differ from those below the anticipated water line. If the prepared seed bed becomes crusted or eroded, or if ruts or depressions exist for any reason prior to TRM installation, the contractor shall rework the soil until it is smooth and re-seed the reworked areas.

Seeding after TRM Installation.

- After installation of the TRM, apply seed.
- After seeding, spread and lightly rake 1/2-3/4 inch of fine topsoil into the mat apertures to completely fill mat thickness. Use backside of rake or other flat implement.
- Spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.
- Do not drive tracked or heavy equipment over mat. Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes or brooms for fine grading and touch up.
- Smooth out soil filling, just exposing top netting of matrix.

TRM Installation in Channel Bottom. TRMs shall always be unrolled in the direction of water flow. First, install the TRM in the channel bottom. Try to minimize the number of seams that are placed on the bottom of the channel, as these are sites of weakness. Do not put seams in the center of the channel bottom or in areas of concentrated water flow. When installing two TRMs side by side in a waterway, the center of the TRM shall be centered in the area of concentrated water flow. Install adjoining TRMs away from the center of the channel bottom. Follow the manufacturer's recommendations for overlapping the TRM; generally the overlap will be 2-4 inches.

Secure the TRM at the beginning of the channel with a 6 inch x 6 inch check slot dug perpendicular to the direction of water flow across the entire width of the channel. Lay the TRM in the check slot with 30 inches extending upstream of the check slot. Stake or staple the TRM in the check slot on 12-inch centers. Backfill the anchor trench and compact the soil. Place seed over the compacted soil if necessary. Cover the compacted soil with the remaining 12 inches of the terminal end of the TRM. Staple or stake the terminal end of the TRM down slope of the anchor trench on 12-inch centers.

Check Slots. "Check slots" (cutoff trenches) must be provided every 25 to 50 feet to ensure water moving under the TRM is forced back to the surface. Longitudinal check slots are required to ensure off-site "side flows" do not get under the TRM. Similarly, beginning and terminal check slots are critical. Check slots can

be installed in one of two ways, depending upon the Engineer's discretion and/or the manufacturer's recommendations.

One type of check slot is constructed by installing a double row of staples or stakes staggered and spaced 4 inches apart. The second option is to install a check slot 6 inches wide by 6 inches deep, and secure the TRM in the upstream side of the check slot with staples or stakes on 12-inch centers. Flip the TRM roll on the upstream edge. Back fill the check slot and compact the soil. Continue rolling the TRM downstream over the completed check slot.

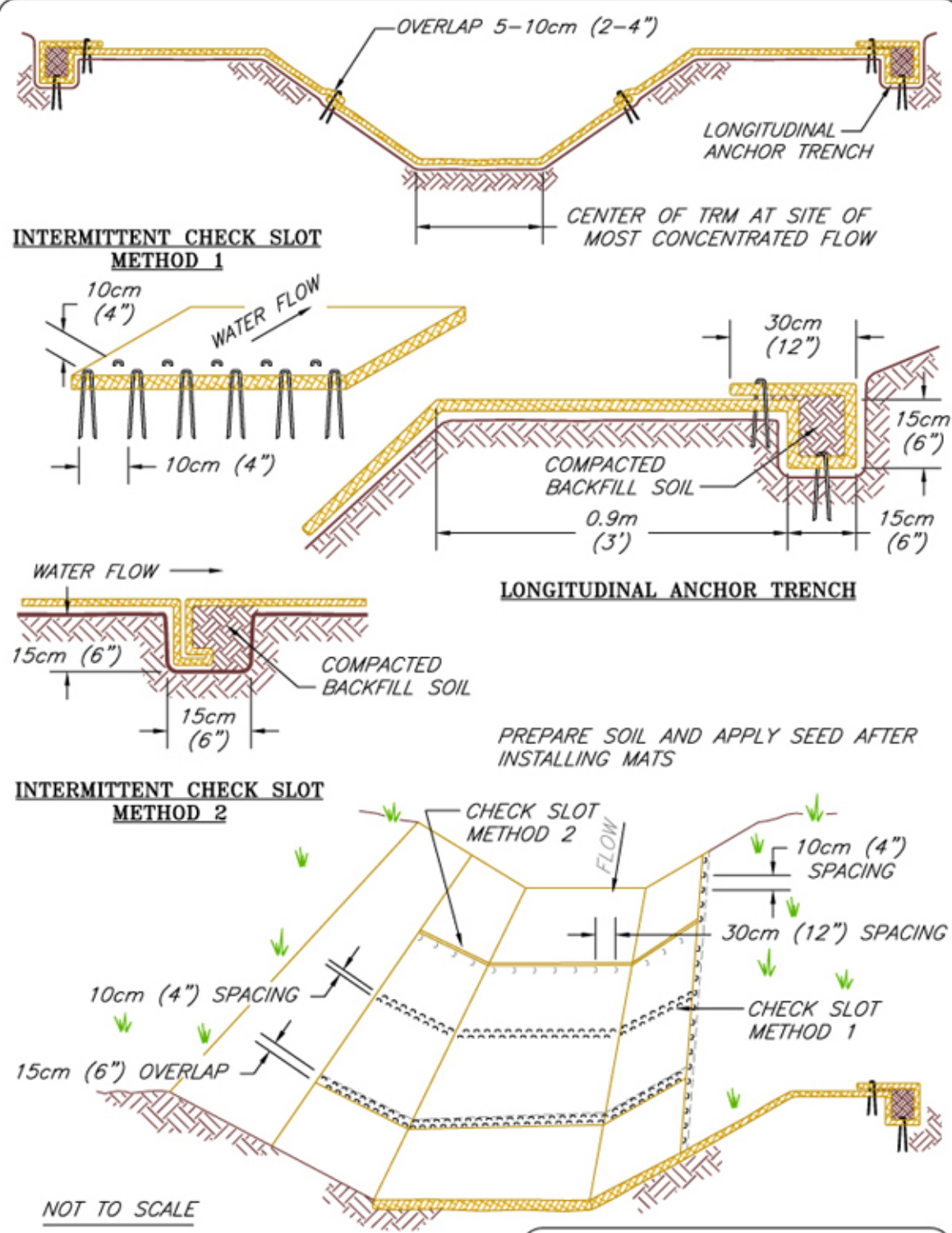
Installation on Side Slopes. As the TRM is installed from the channel bottom up the slope, a shingle-type installation is recommended with the up-slope TRM overlapping the lower TRM approximately 2-4 inches. Anchor the TRMs with a minimum of one staple every 24 inches across the width and one staple every 36 inches down the length. If the TRM needs to be spliced, "shingle" it as discussed above, with a 4-inch overlap. Use a staple check slot to secure the overlap. Anchor the TRM placed at the top of the channel slope in the same manner as described in the slope section.

Terminal End. Secure the TRM at the terminal end of the channel with a check slot similar to the one made at the beginning of the channel.

Alternative Channel Installation Method. Another installation method for TRMs is to install them vertically and approximately 3 feet onto the flat of the channel bottom. Construct a check slot in areas of concentrated water flow. Use a 2-4 inch shingle-type overlap upstream to downstream.

Monitoring/Maintenance: Basic monitoring consists of visual inspections to determine mat integrity and attachment performance. Rill development beneath the mat or edge lifting are evidence of inadequate attachment. Additional staking and trenching can be employed to correct defects. Recently placed mats may be replaced, but once vegetation becomes established, replacement is not a reasonable option.

Common Failures: Critical points in conveyance system applications where mats can lose support include points of overlap between mats, projected water surface boundaries and channel bottoms.



TRENCH DRAIN – RC-6

Application: A trench drain is a gravel drain, construction with or without perforated pipe and filter fabric that is installed to intercept and divert shallow seepage away from the face of a streambank or divert surface runoff in a situation where a drainage swale or temporary diversion dike is not appropriate.

Design Guidelines: Trench drains should be considered when shallow, water bearing strata that conducts groundwater to emerge (daylights) at a streambank. A good example would be relatively permeable surface strata or water bearing sands up to 10 feet thick; for example, outwash sand or coarse alluvium overlying relatively impermeable silty clay deposits.

Materials/Equipment: Suitable drainage rock or gravel in addition to a perforated polymeric pipe. A small backhoe is required for excavating and backfilling the trench. A geotextile filter fabric will be required if the trench is to be lined.

Construction Specifications/Installation: A drainage trench is excavated parallel to and just behind the crest of a streambank or sensitive area. The bottom of the trench shall be keyed into an impermeable layer in the slope. The trench shall be backfilled with a coarse graded aggregate that meets filtration criteria; i.e., it shall allow unimpeded flow of groundwater while excluding fines from the seepage water. Alternatively, the trench can first be lined with a filter fabric (geotextile) that meets the filtration requirements and then be backfilled with a coarse aggregate. The purpose of the trench is to intercept and divert shallow seepage away from the face of the streambank/sensitive area. [Trench drains must connect to a surface discharge pipe or otherwise may be classified as a Class V Underground Injection (UIC) well requiring registration for rule authorization with DEQ.]

Trench Drains constructed without a pipe at the bottom are commonly known as French Drains (see Figure RC-6.1a). An efficient, well-constructed Trench Drain requires the use of perforated, jointed, slotted, or porous pipe placed near the bottom of a trench (see Figure RC-6.1b) that is surrounded with pea gravel or selected pervious filter aggregate. When a drain is excavated in erodible materials, synthetic filter fabrics (geotextiles) shall be used (see Figure RC-6.1c) to line the sides and bottom of the trench to prevent soil fines from entering the coarse backfill in the drain. The main backfill shall be specially selected pervious filter aggregate designed to allow unrestricted flow of water to the pipes.

Most drains should be equipped with pipes because gravel or rock-filled trenches have limited discharge capabilities even when clean aggregates are used. The discharge capabilities of drainage trenches backfilled with clean stone or coarse gravel, as estimated by Darcy's law, are given in Table RC-6.1. The required diameters of corrugated metal, concrete, and polymeric (smooth) drain pipes for a wide range of discharge quantities can be determined from the nomograph in Figure RC-6.2.

- The location of perforations and open joints in pipes shall always be placed to allow unobstructed flow to pipes.
- If a drainage pipe is completely surrounded with specially selected coarse filter aggregate (refer to Figure RC-6.1b), perforations can completely surround the pipe.

Trench drains shall discharge to stabilized areas or outlets only. Trench drains shall not discharge to steep slopes or disturbed/denuded areas. Instead, a stabilized conveyance system such as a slope drain (RC-1), stabilized diversion dike (RC-4), or a grass-lined channel (RC-5) shall be used to discharge flows to a stabilized area or outlet. Maximum trench depths are restricted to the reach of a backhoe/excavator or approximately 6-8 feet.

- Trench widths are also determined by the width of the excavator bucket, which can range from 12 to 24 inches.

- The water transmission characteristics of the drainage trench can be improved by placing a perforated or slotted drainage pipe on a slight grade at the bottom.
- The discharge from a trench drain shall be conveyed in a safe, non eroding manner down the slope directly to the stream.

Monitoring/Maintenance: Subsurface drains, including trench drains, are difficult to access and inspect once installed. A possible way to monitor the performance of a trench drain is to check the outflow from the pipe at the bottom of the interceptor trench. If there is steady shallow seepage towards a streambank, this exit pipe shall flow continuously. The effectiveness of a trench drain for intercepting shallow seepage can be monitored indirectly by examining for signs of seepage and/or slumping/sliding at the bank face.

Common Failures: The limitations of trench drains cited previously are the most common reasons for failure. Failure to excavate the trench deep enough to reach the impermeable base of a perched groundwater system may let ground water pass under the trench. Loss of drainage capacity from clogging of a drain can lead to the saturation and buildup of pore pressure in the streambank itself. Either of these conditions can lead to mass stability failure of a streambank or seepage induced erosion of the bank face.

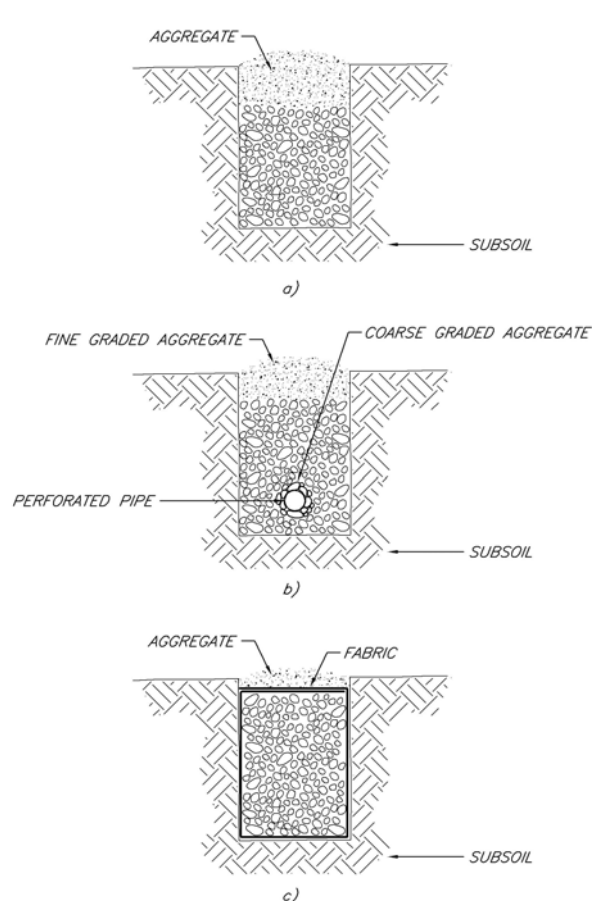


Figure RC-6.1. Cross sections of subsurface drains.
a) French drain,
b) Conventional trench drain with pipe,
c) Trench drain with filter fabric.

Size of stone	Permeability, ft/day	Slope	Capacity	
			cu ft/day	gpm
2 to 1 in.	120,000	0.01	7200	38
1 to 1/2 in.	120,000	0.001	720	4
1/2 to 3/4 in.	30,000	0.01	1800	9
3/4 to 1 in.	30,000	0.001	180	1
3/8 to 1/2 in.	6,000	0.01	360	2
1/4 to 3/8 in.	6,000	0.001	36	0.2

Table RC-6.1. Discharge capacities of 3 x 2 feet cross sections of stone filled, trench drains.

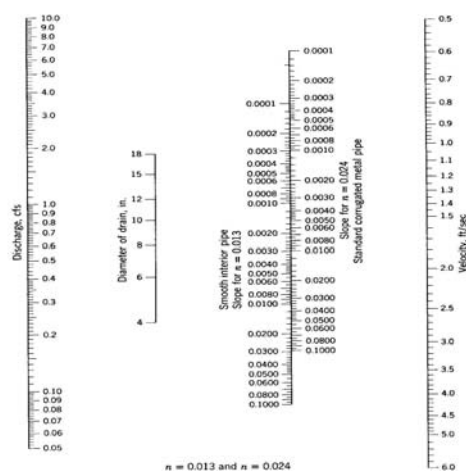


Figure RC-6.2. Nomograph for computing required size of circular drain, flowing full.

DROP INLET – RC-7

Application: Runoff passing over the top of slopes or embankments can trigger or expand gully erosion. Pondered water above the edge of a steep slope or bank can lead to slope failures through pressure, seepage, or infiltration into an unstable or denuded slope. A drop inlet is used to convey concentrated overbank runoff from the top to the toe of a slope. It is an L-shaped corrugated pipe that directs flow—usually originating from concentrated flow, or a drainage channel, ditch, or gully—through an earthen embankment. The pipe collects flow from the top of slope at the concentrated flow to a stabilized area at the toe of slope. The installation of drop inlets can reduce or eliminate gully erosion and downcutting at steep slopes.

Design Guidelines: Drop pipe structures are generally used with drainage channels or gullies deeper than 10 feet and embankments ranging from 15 to 20 feet high. Embankment slopes for drop inlets should range from 1H:1V to 3H:1V.

Materials/Equipment: Earthmoving equipment and erosion prevention measures are required for construction and stabilization of the embankment. Fill may need to be imported from offsite in addition to pipes, trash racks, and stone for construction.

Construction Specifications/Installation:

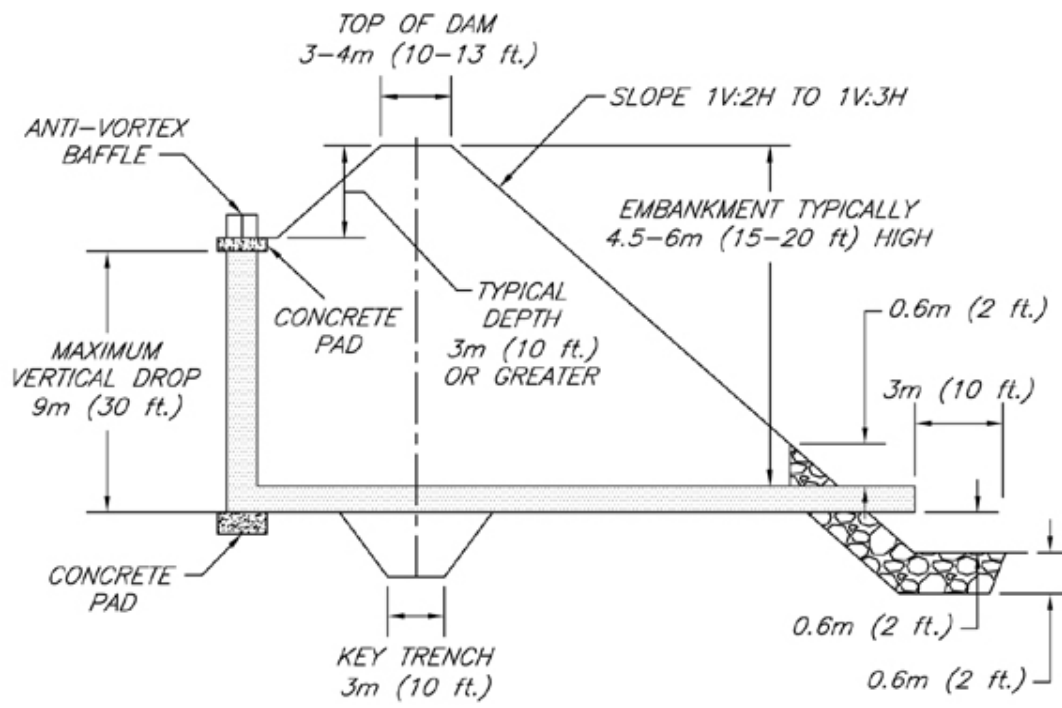
- Pipes shall be sized to convey the 2- to 10-year storm event based on standard USDA Soil Conservation Service runoff curve number computations. An emergency spillway should be provided to convey flows larger than the design discharge. Drop inlets are designed for discharges less than 200 ft³/sec, with a vertical distance from the inlet weir crest to the outlet pipe invert less than 30 feet. The pipe diameter and length are used to compute head-discharge relations, but allowing for the pipe diameter to be adjusted to avoid orifice flow at discharges less than or equal to design flow.
- Proper compaction of the dike (RC-4), berm, or dam at the inlet is necessary for integrity of the structure and to allow for ponding without seepage.
- Drop pipes may be designated non-storage structures, which are sized to pass the 2- to 5-year event, or as temporary storage structures, which are designed to impound runoff from the 25-year event. Water retention is governed by site factors (e.g., soils, topography, and water supply) and by the elevation of the inlet weir and emergency spillway.
- Pipe materials can be either aluminized or galvanized polymer-coated metal or polymeric materials. To prevent seepage through the earthen embankment seepage collars for structures with conduits less than 4 feet in diameter and with annular filter drainage rings for conduits greater than 4 feet.
- When the structure is designed to impound water permanently, a filter drainage diaphragm shall be used, concrete pads shall be provided at the top and bottom of the vertical pipe, and an anti-vortex baffle shall be placed in the inlet to maintain weir flow and avoid vibration during large events. Outlets are supported with grouted riprap and secured with screw anchors. In addition, stone erosion protection shall be provided at the outlet for structures greater than 4 feet in diameter.
- Ensure the inlet pipe is higher than the ponding height at the inlet.
- Check dams (RC-11) may be required in the drainage channel prior to the inlet of the structure to reduce velocities and prevent gully erosion and sediment transport.
- Inlet protection may be required at the inlet structure to prevent sediment transport through the structure.

Monitoring/Maintenance: Routine inspections are required to ensure the structure is working correctly. Maintenance is required to prevent clogging at the entrance of the structure or trash rack for removal of sediment accumulations in the ponded area at the base of the inlet structure, and to maintain inlet protection. The upstream drainage channel shall be inspected for gully erosion and maintenance of the check dams. If the

residence time in the ponded area at the inlet structure is not long enough, a taller inlet pipe may be necessary to allow for more settling of sediments.

Common Failures:

- Clogging of the down-pipe leading to overtopping of the containment dike and erosion of the downstream face of the structure embankment.
- Uncontrolled sediment loading from the upstream drainage channel runoff conveyed through the structure to the receiving stream, channel, or designated discharge point.
- Sediment discharges from the ponded area around the structure's inlet because of maintained inlet protection (SC-8) at the inlet structure.
- Too short of an inlet structure causing too short of a residence time in the ponded area prior to discharge to the inlet.



DROP INLET

IN-STREAM DIVERSION TECHNIQUES – RC-9

Application: A stream diversion is a temporary bypass through a pipe, flume, or excavated channel that carries water flow around in-stream work areas. Stream diversions are commonly used during culvert installations or replacements. Where possible, a stream diversion should be the first choice to control erosion and sediment during the construction of culverts or other in-stream structures. During construction in a watercourse, particularly for culvert installation and repair, these temporary water bypass structures are an effective sediment and erosion control technique.

Design Guidelines: The selection of which in-stream diversion technique to use will depend upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

Advantages	Disadvantages
Pumped Diversion	
<ul style="list-style-type: none">• Downstream sediment transport can almost be eliminated• De-watering of the work area is possible• Pipes can be moved about to accommodate construction operations• The dams can serve as temporary access• Increased flows can be managed by adding more pumping capacity	<ul style="list-style-type: none">• Flow volume is limited by pump capacity• Requires 24-hour monitoring of pumps• Sudden rain could overtop dams• Minor in-stream disturbance to install and remove dams
Excavated Channels and Flumes	
<ul style="list-style-type: none">• Isolates work from water flow and allows dewatering• Can handle larger flows than pumps	<ul style="list-style-type: none">• Bypass channel or flume must be sized to handle flows, including possible floods• Channels require stabilization• Flow diversion and then re-direction with small dams causes in-stream disturbance and sediment

In-stream diversions shall not be used without identifying potential impacts to the stream channel, or until all necessary permits have been obtained. Check with federal and state regulatory authorities (e.g., U.S. Army Corps of Engineers, Oregon Division of State Lands, Oregon Department of Fish and Wildlife, NOAA Fisheries) for permitting and design requirements. Some issues that need to be addressed include removal/fill, in-water work period, fish passage, intake screening, water quality, and site restoration.

Materials/Equipment: Primary and backup pumps, culvert material, intake screen, check dam materials.

Construction Specifications/Installation:

- The pumped diversion is suitable for intermittent and low flow streams that can be pumped. Pump capacity must be sufficient for design flow. The upper limit is about 10 ft³/sec, the capacity of two 8-inch pumps.
- A temporary dam is constructed upstream and downstream of the work area and water is pumped through the construction project in pipes. Dam materials shall be selected to be erosion resistant, such as steel plate, sheet pile, sandbags, continuous berms, inflatable water bladders, etc.

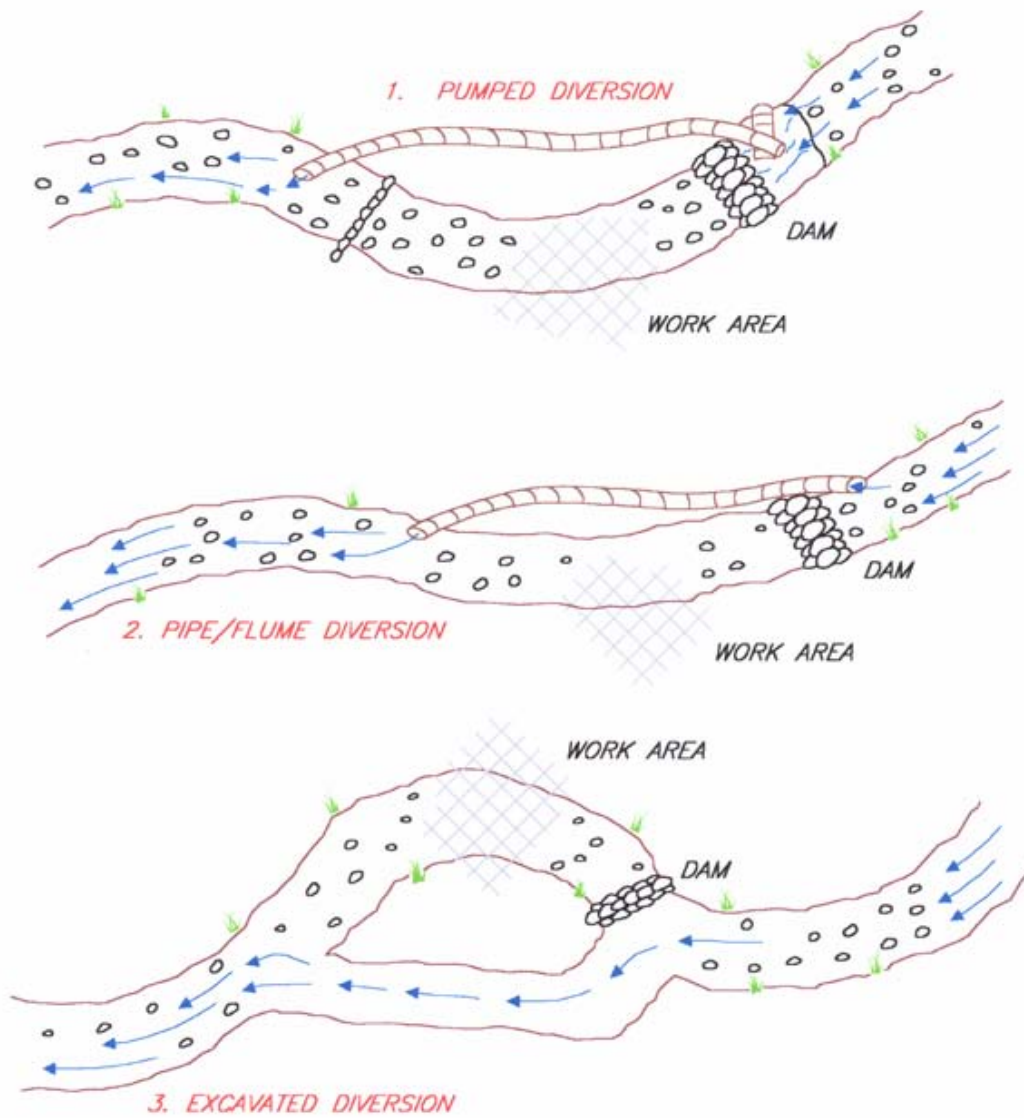
- A temporary bypass channel can also be constructed by excavating a temporary channel or passing the flow through a heavy pipe (called a flume), and excavating a trench under it. Typical stream sizes are less than 20 feet wide and less than 100 ft³/sec.

Monitoring/Maintenance:

- All stream diversions must be closely maintained and monitored.
- Pumped diversions require 24-hour monitoring of pumps.
- Upon completion of the work performed, the stream diversion shall be removed and flow shall be re-directed through the new culvert or back into the original stream channel.

Common Failures:

- Insufficient pump capacity.
- No contingency pump on site.



TYPICAL STREAM DIVERSION TECHNIQUES

IN-STREAM ISOLATION TECHNIQUES – RC-10

Application: An in-stream isolation technique is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. During construction in a watercourse, these structures are designed to reduce turbidity and sediment discharge.

Design Guidelines: Isolation structures may be used in construction activities such as streambank stabilization, culvert installation, bridges, piers or abutments. They may be used in combination with other methods such as clean water bypasses and/or pumps.

This technique shall not be used:

- If there is insufficient streamflow to support aquatic species.
- In deep water unless designed or reviewed by a professional engineer.
- To completely dam streamflows.

Materials/Equipment: The structures may be made of rock, sand bags, wood or water-filled geotextiles (aqua barriers). Materials for isolation structures shall be selected based on ease of maintenance and complete removal following construction activities.

Construction Specifications/Installation:

Construction specifications shall be site specific. See notes on details. When used in watercourses or streams, isolation structures must be used in accordance with applicable federal and state regulations administered by the U.S. Army Corps of Engineers and Oregon Division of State Lands. Issues to be addressed include in-water work periods, fish salvage requirements, fish passage regulations, and turbidity thresholds.

Monitoring/Maintenance:

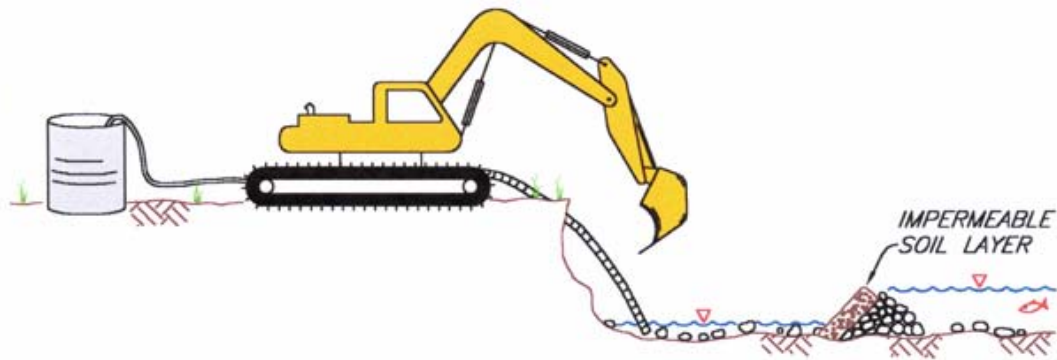
- During construction, inspect daily.
- Schedule additional inspections during storm events.
- Immediately repair any gaps, holes or scour.
- Remove sediment buildup.
- Upon construction completion, remove structure. Recycle or re-use if applicable.
- Revegetate areas disturbed by removal of berm or cofferdam as required.

Common Failures:

- Wetland removal/fill permit requirements.
- Lack of fish handling permit from NOAA Fisheries/Oregon Department of Fish and Wildlife.
- Restrictions to avoid harm of endangered and threatened fish species.
- Insufficient pump capacity.
- Restrictions on pile driving.

BENEFITS/LIMITATIONS

- Allows partial dewatering
- Relatively inexpensive
- Useful for small streams
- Minimal TSS when removed



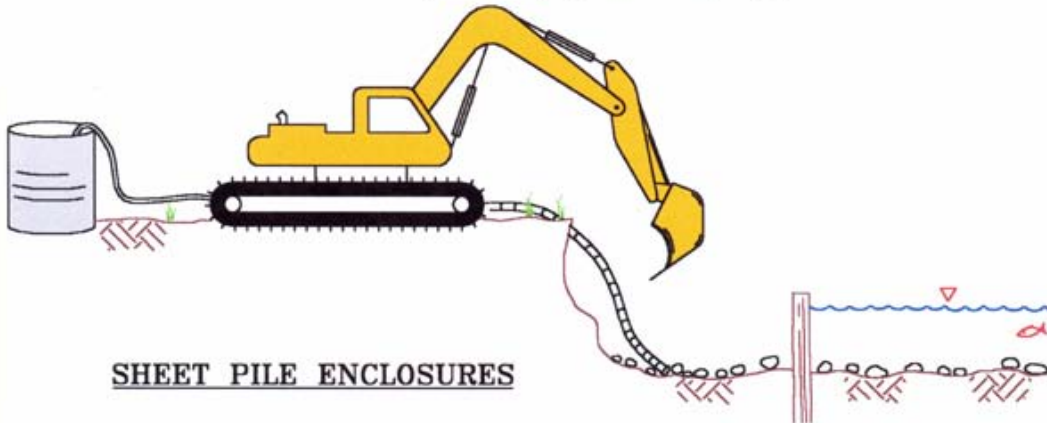
NOTES:

- Step 1. Install clean gravel*
- Step 2. Place impermeable soil*
- Step 3. Do work*
- Step 4. Decommission berm by removing soil layer first*
- Step 5. Pump work area. Head differential will cause turbid water to flow into work area through gravel*
- Step 6. Remove or spread gravel*

**GRAVEL/SOIL BERM INSTREAM
ISOLATION TECHNIQUE**

BENEFITS/LIMITATIONS

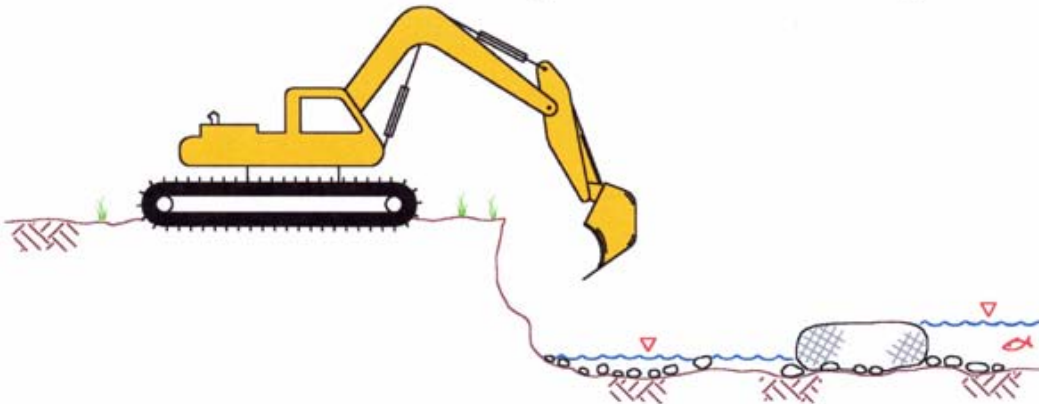
- Allows full dewatering
- Relatively expensive
- Useful in large rivers, lakes, high velocity
- Not really appropriate for small streams
- Requires staging and heavy equipment access areas



SHEET PILE ENCLOSURES

BENEFITS/LIMITATIONS

- Allows partial dewatering
- Moderately expensive
- Ease of installation and removal unknown
- Can be designed for small streams to large rivers

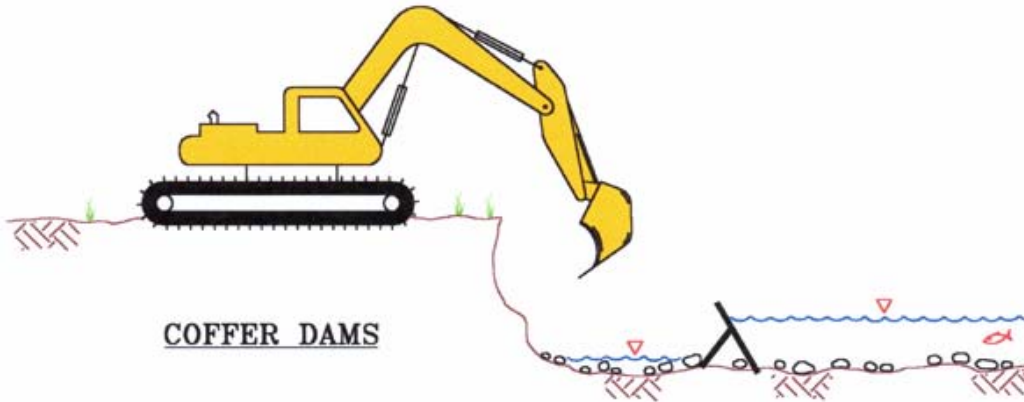


WATER-FILLED GEOTEXTILE (AQUA DAM)

**INSTREAM EROSION AND SEDIMENT
CONTROL ISOLATION TECHNIQUES**

BENEFITS/LIMITATIONS

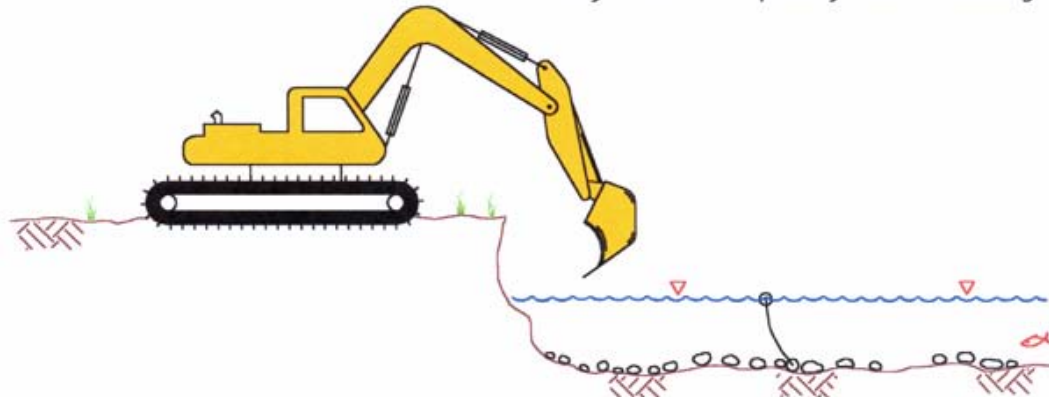
- Allows partial dewatering
- Many different types available
- Relatively expensive
- Can be designed for large and small streams
- Ease of installation and removal unknown



COFFER DAMS

BENEFITS/LIMITATIONS

- Does not allow dewatering
- Inexpensive
- Used in slow water or lakes only
- Not very effective especially when removing



GEOTEXTILES, SILT BARRIERS, CURTAINS

**INSTREAM EROSION AND SEDIMENT
CONTROL ISOLATION TECHNIQUES**

CHECK DAMS – RC-11

Application: A check dam is a small, temporary dam placed across a natural or man-made channel or drainage ditch. Check dams reduce drainage ditch erosion caused by storm water runoff, by restricting the velocity of flow in the ditch. Check dams are often used as a temporary measure while a channel is being permanently lined with vegetation or other materials to prevent erosion.

Design Guidelines: Check dams shall be placed at a distance and height to allow small pools to form behind them. The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Materials/Equipment: Check dams can be constructed of rocks, logs, timbers, or gravel-filled bags. If gravel-filled bags:

Bag Material. Bags shall be either polypropylene, polyethylene or polyamide woven fabric, minimum unit weight four ounces per square yard, mullen burst strength exceeding 300 psi in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

Bag Size. Each gravel-filled bag shall have a length of 18 inches, width of 12 inches, thickness of 3 inches, and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the engineer for approval prior to deployment.

Fill Material. Fill material shall be between 0.4 and 0.8 inches in diameter, and shall be clean and free from clay balls, organic matter, and other deleterious materials. The opening of gravel-filled bags shall be secured such that gravel does not escape. Gravel-filled bags shall be between 28 and 48 lbs in mass. Fill material is subject to approval by the engineer.

Construction Specifications/Installation:

- High flows (typically a 2-year storm or larger) shall safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams shall be removed when grass has matured sufficiently to protect the ditch or swale.
- Construct rock dams such that structures are not damaged by vehicles and do not impede travel ways.
- Rock dams shall be constructed of 2-15 inch rock.
- Keep the center rock (spillway) section at least 6 inches lower than the outer edges.
- Extend the abutments 18 inches into the channel bank.
- Gravel bags or biobags may only be used as check dams with the following specifications:
 - Install along a level contour.
 - Tightly abut bags and stack bags using a pyramid approach. Bags shall not be stacked any higher than 3 feet.
 - Upper rows of bags shall overlap joints in lower rows.
- Local and state requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.

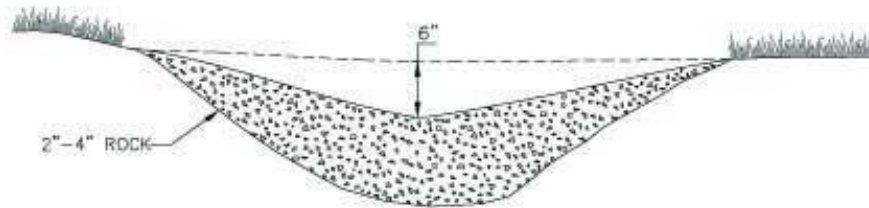
Monitoring/Maintenance:

- Inspect check dams before, during, and after each rainfall event. Repair damage as needed.
- Remove sediment when depth reaches one-third the height of the check dam.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

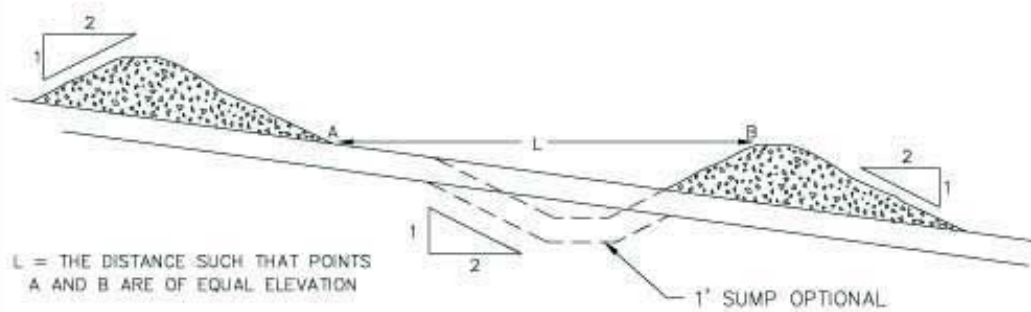
- Removed sediment shall be incorporated in the project or disposed of properly.

Common Failures:

- Insufficient ballast in dam to resist blowout.
- Side-cutting if not keyed into slopes.
- Bags can degrade over time.



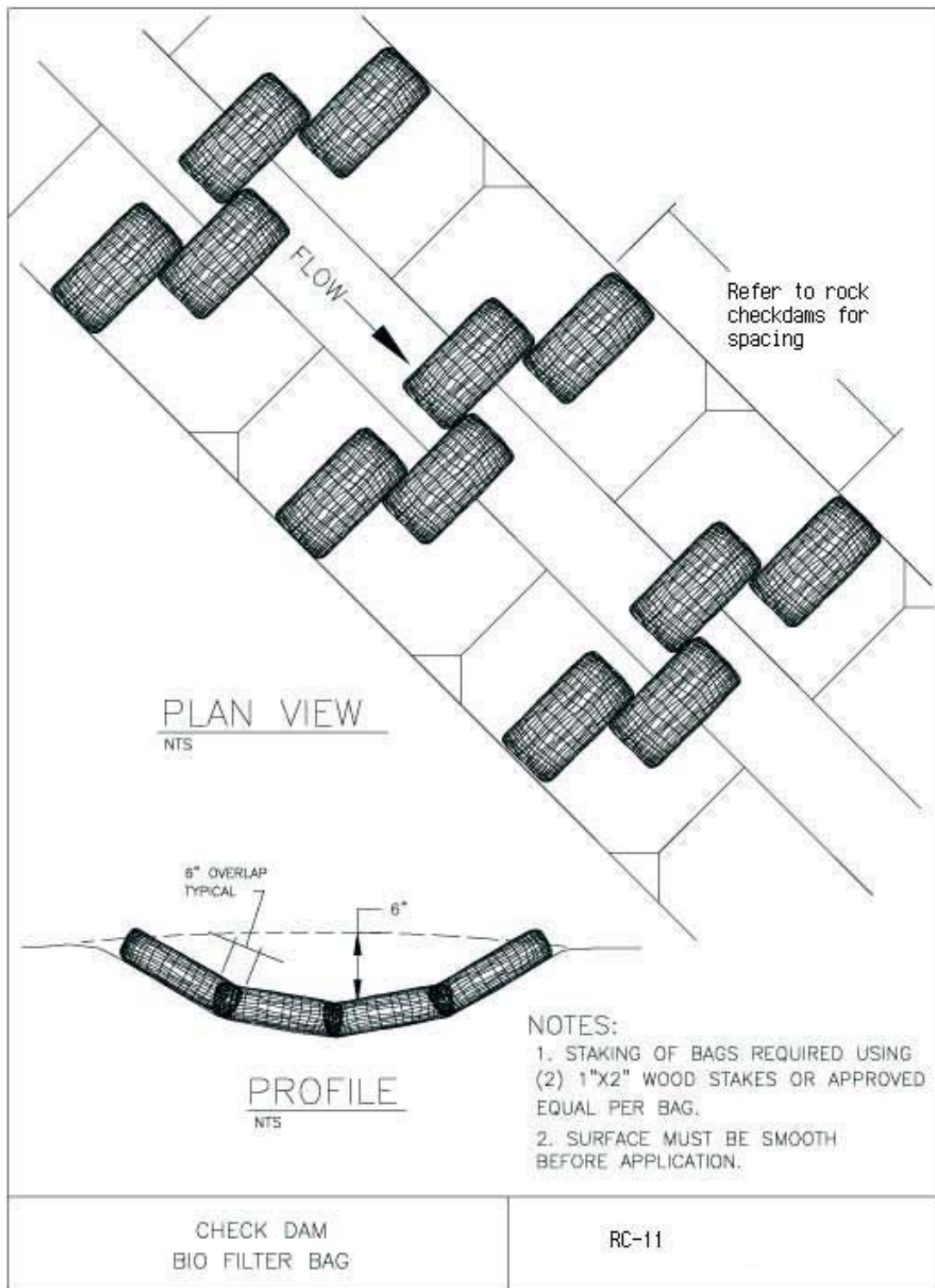
ROCK CHECK DAM



SPACING BETWEEN CHECK DAMS

CHECK DAM
ROCK

RC-11



EPSC Details For Sediment Control

SEDIMENT FENCE – SC-1

Application: A linear barrier and perimeter control is designed for sheet flow, not concentrated flow. It is used as a temporary measure that intercepts sediment-laden runoff and filters or traps sediment or non-stormwater flows behind the barrier. It should not be placed across stream channels.

Design Guidelines: A last line of defense before stormwater leaves the site, and must be carefully selected, properly installed, and diligently maintained. The contributory drainage area shall not exceed 100 square feet per lineal foot of fence.

Materials/Equipment: Prefabricated fence fabric shall consist of material approved by its manufacturer for use in sediment fence applications and shall include pre-fabricated pockets for stake installation. Select standard duty or heavy duty prefabricated sediment fence based on criteria described below.

Construction Specifications/Installation:

- Standard or heavy duty sediment fence shall have manufactured stitched loops with 2-inch x 2-inch x 4-foot posts. Stitched loops shall be installed on the uphill side of the slope.
- Sediment fence shall be installed a minimum of 3 feet from the toe of a slope to maximize storage.
- A trench shall be excavated deep enough so that 6 inches of the fabric is buried along the line of the posts.
- The trench shall be backfilled with soil and compacted on both sides of the sediment fence.
- When a sediment fence must be overlapped, join the two end stakes by wrapping them in at least one and a half turns of fabric and driving the joined stakes into the ground together.
- At the end point of a sediment fence, angle the fence slightly uphill for one full 6-foot panel.
- Sediment fence shall be installed along contours at intervals noted in Table SC-1.1 below.

TABLE SC-1.1. SEDIMENT BARRIER SPACING		
Percent Slope	Slope	Maximum Spacing
<20	Less than 5H:1V	100 feet
20 to 30	5H:1V to 3H:1V	50 feet
> 30	Greater than 3H:1V	25 feet

Standard Duty Prefabricated Sediment Fence

- Slope of area draining to fence is 4H:1V or less.
- Use is limited to less than 5 months.
- Area draining to fence produces moderate sediment loads.
- Layout and install in accordance with attached BMP detail.

Heavy Duty Prefabricated Sediment Fence

- Slope of area draining to fence is 1H:1V or less.
- Use is limited to 8 months. Longer periods may require fabric replacement.
- Area draining to fence produces moderate sediment loads.

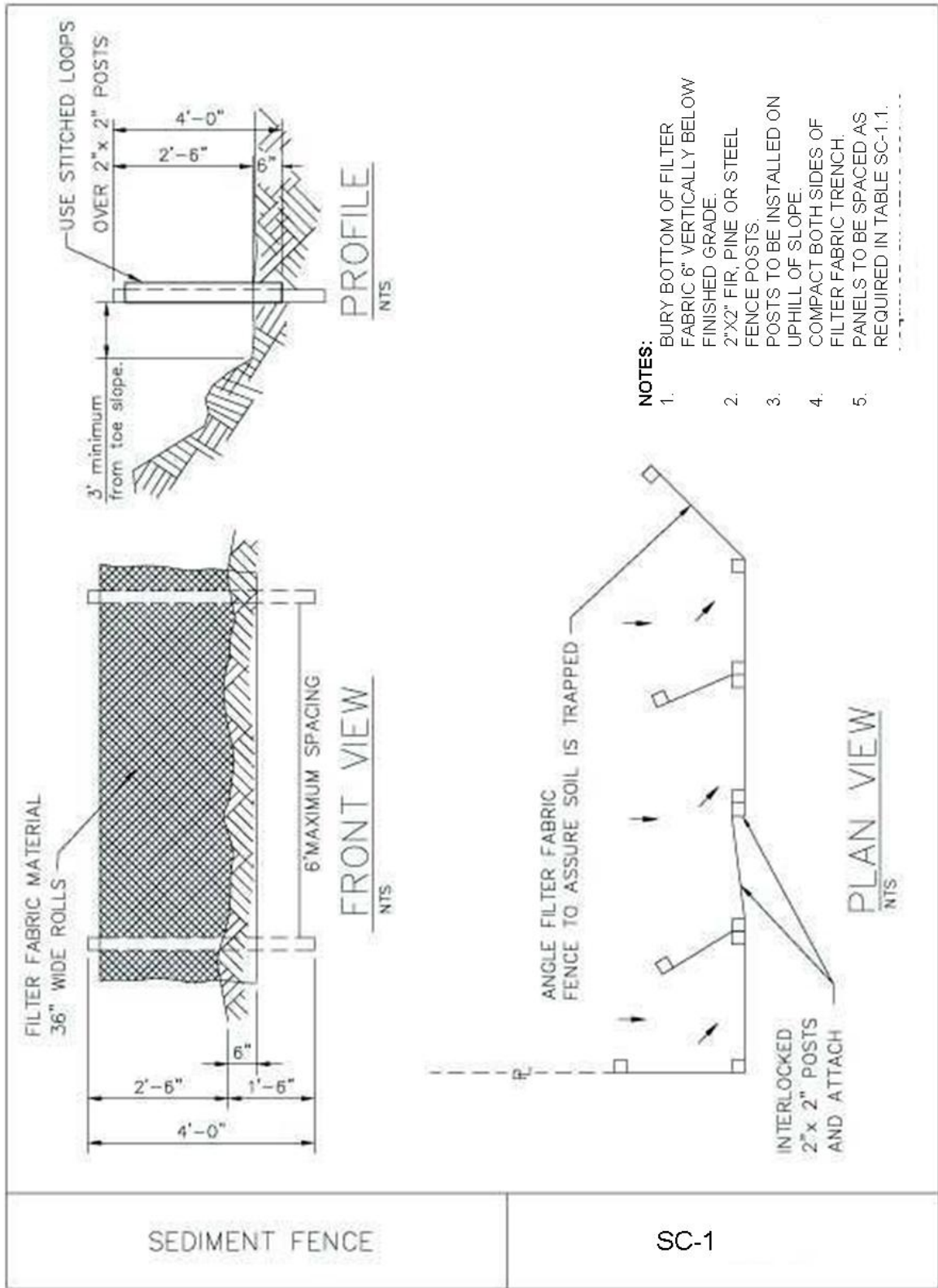
- Heavy duty sediment fences typically have the following physical characteristics:
 - Fence fabric has greater tensile strength and permittivity than other available fabric types, and may be reinforced with a backing or additional support to increase fabric strength.
 - Posts are spaced closer together than other available pre-manufactured sediment fence types.
- Layout and install in accordance with attached typical layout and BMP detail.
- Except for the fence ends, the difference in elevation between the highest and lowest point along the top of the sediment fence shall not exceed one-third the fence height.

Monitoring/Maintenance:

- Repair undercut sediment fences.
- Repair or replace split, torn, slumping, or weathered fabric.
- Inspect sediment fence before, during, and after storm events.
- Any required repairs shall be performed as soon as possible and before any predicted storm events
- Remove sediment when accumulation reaches 1/3 the fence height.
- The removed sediment shall be incorporated in the project, disposed of properly, or appropriately stabilized with vegetation.
- Remove sediment fence when it is no longer needed and when the upslope area has been stabilized. Fill and compact post holes and anchorage trench, remove sediment accumulation, and grade fence alignment to blend with adjacent ground.

Common Failures:

- Improper installation.
- Poor maintenance—sediment shall be removed when accumulation reaches 1/3 of the fence height.



SAND BAG BARRIER – SC-2

Application: Linear barrier and perimeter control. Sand bag barriers are designed for sheet flow, not concentrated flow, and must never be placed across a stream or channel. A temporary measure that intercepts sediment-laden runoff and filters or traps sediment or non-stormwater flows behind the barrier.

Design Guidelines: Sand bags are much less permeable than gravel bag berms and are appropriate when used to block and contain non-stormwater flows (e.g., discharges from concrete saw cutting), but can result in flooding when used to control stormwater flows. Topography and drainage patterns are important considerations in the design of the linear barriers. Barriers shall be placed on the same contour, and it is important that barriers be properly installed and keyed into the soil to prevent undermining (i.e. flow passing under the barrier). Sand bag barriers are intended to block and divert flow. They are not intended to be used as filtration devices. As a last line of defense before storm water leaves the site, they must be carefully selected, properly installed, and diligently maintained.

Materials/Equipment:

- **Bag material.** Sand bag shall be polypropylene, polyethylene or polyamide woven fabric, minimum unit weight 4 ounces per square yard, mullen burst strength exceeding 300 psi in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap is not acceptable.
- **Bag size.** Each sand-filled bag shall have a length of 18 inches, width of 12 inches, thickness of 3 inches, and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the engineer for approval prior to deployment.
- **Fill material.** All sand bag fill material shall be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material. Fill material is subject to approval by the engineer.

Construction Specifications/Installation:

- Install along a level contour.
- Turn ends of sand bag row up slope to prevent flow around the ends.
- Sand bag barriers shall be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.
- Construct sand bag barriers with a set-back of at least 3 feet from the toe of a slope. Where it is determined to be not practical due to specific site conditions, the sand bag barrier may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practicable.
- Sand bag barriers, as well as other sediment barriers, shall be installed on the contour at intervals noted in Sediment Fence BMP, Table SC-1.1.
- Sand bag barriers can be used as a diversion technique, see Temporary Diversion Swale (RC-3).

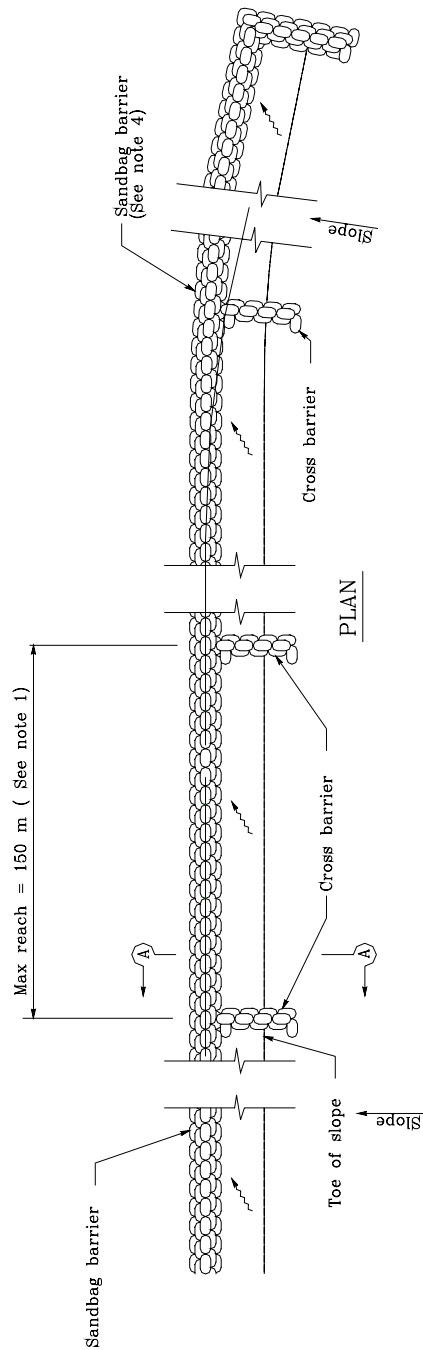
Monitoring/Maintenance:

- Inspect barriers before, during, and after each rainfall event, and weekly throughout the rainy season.

- Reshape or replace sand bags, as needed.
- Repair washouts or other damages, as needed.
- Inspect sand bag barriers for sediment accumulations and remove sediment when accumulation reaches 1/3 the barrier height. Removed sediment shall be incorporated in the project at locations designated by the engineer or shall be disposed of properly.
- Remove sand bags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilized the area.

Common Failures:

- Sand bags not placed along contour.
- Sand bags may degrade over time.



TEMPORARY LINEAR SEDIMENT BARRIER (TYPE SANDBAG)



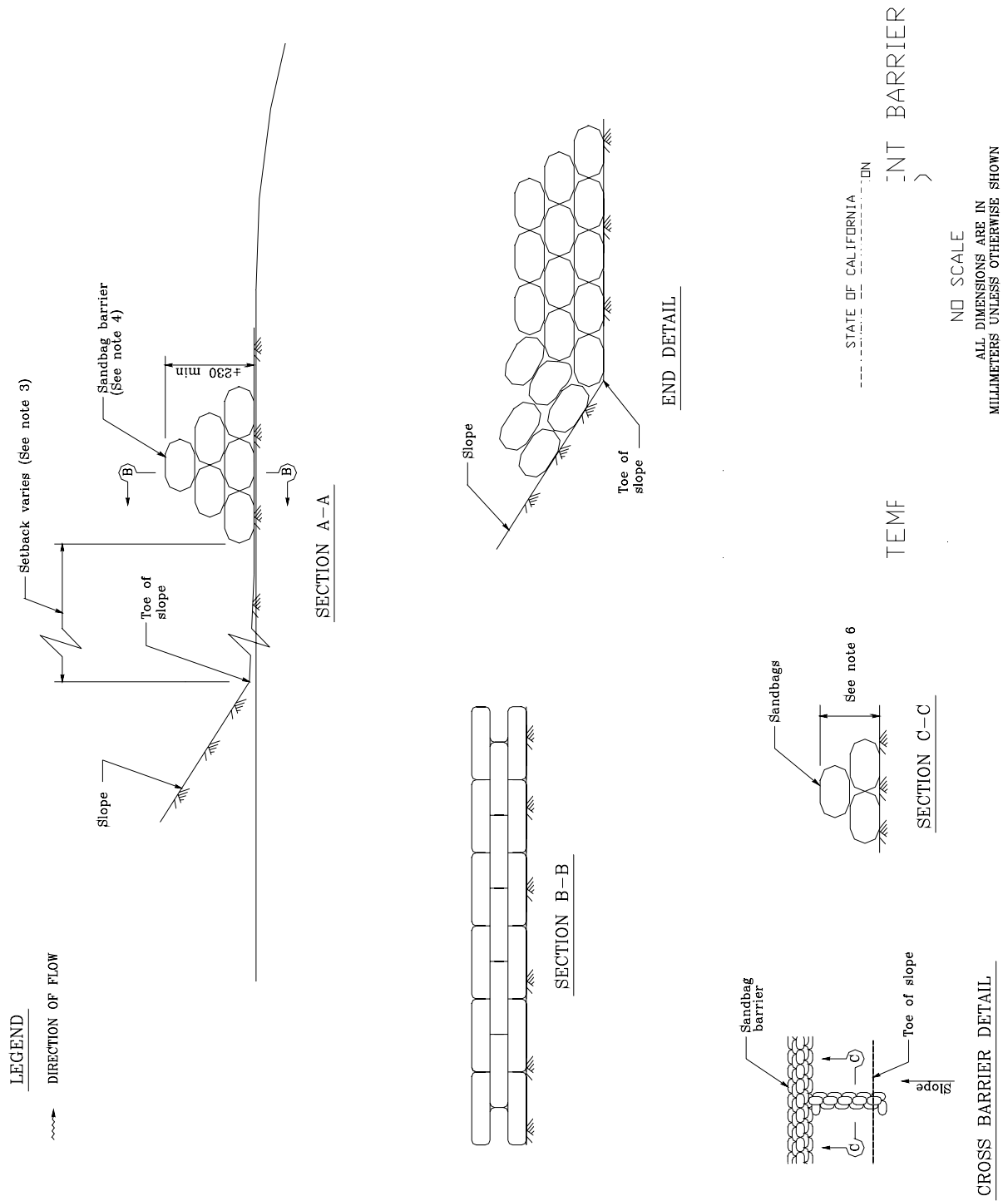
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

TEMPORARY LINEAR SEDIMENT BARRIER
(TYPE SANDBAG)

NO SCALE
ALL DIMENSIONS ARE IN
MILLIMETERS UNLESS OTHERWISE SHOWN

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed $1/2$ the height of the linear barrier. In no case shall the reach length exceed 150 m.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of $1/2$ and a max of $2/3$ the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.



GRAVEL BAG BERM – SC-3

Application: A linear barrier and perimeter control. A temporary measure that intercepts sediment-laden runoff and filters or traps sediment or non-stormwater flows behind the barrier.

Gravel bag berms and other devices that allow filtration should be used for sediment control applications where the goal is to slow water and promote ponding behind the barrier but still allow flow through the device to discharge with a reduced flooding potential.

Design Guidelines: It is important to select the correct BMP for the intended application, particularly for the use of gravel bag berms versus sand bags. Gravel bag berms are intended to be used as filtration devices. Similar applications are check dams (RC-11), Type 4 inlet protection (SC-8), and sediment fences (SC-1) because all retain sediment and release water. On the contrary, sand bag barriers (SC-2) block and divert flow, similar to a temporary diversion swale (RC-3). Gravel bag berms are much more permeable than sand bags and are less likely to result in flooding when used to control stormwater flows.

These barriers are designed for sheet flow, not concentrated flow, and must never be placed across a stream or channel. Therefore, the topography and drainage patterns are important considerations in the design when they are used as linear barriers. Barriers shall be placed along a contour, and it is important that barriers be properly installed and keyed into the ground to prevent undermining (i.e., flow passing under the barrier). As a last line of defense before stormwater leaves the site, they must be carefully selected, properly installed, and diligently maintained.

Materials/Equipment:

- **Bag material.** Bags shall be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight 4 ounces per square yard, mullen burst strength exceeding 300 psi in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.
- **Bag size.** Each gravel-filled bag shall have a length of 18 inches, width of 12 inches, thickness of 3 inches, and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the engineer for approval prior to deployment.
- **Fill material.** Gravel shall be between 0.4 and 0.8 inch in diameter, and shall be clean and free from clay balls, organic matter, and other deleterious materials. The opening of gravel-filled bags shall be between 28 and 48 lbs in mass. Fill material is subject to approval by the engineer.
- A certificate of compliance for the gravel and bags shall be provided.

Construction Specifications/Installation:

- When used as a linear control for sediment removal:
 - Install along a level contour.
 - Turn ends of gravel bag row up slope to prevent flow around the ends.
 - Generally, gravel bag berms shall be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.
 - Gravel bag barriers as well as other sediment barriers shall be installed at the contour intervals noted in the Sediment Fence BMP, Table SC-1.1.
- When used for concentrated flows:
 - Stack gravel bags to required height using a pyramid approach.

- Upper rows of gravel bags shall overlap joints in lower rows.
- Construct gravel bag barriers with a set-back of at least 3 feet from the toe of a slope. Where constrained due to specific-site conditions, the gravel bag barrier shall be constructed at the toe of the slope, but as far from the toe of the slope as practicable.
- See Sand Bag Barrier (SC-2) for BMP design details
- **Monitoring/Maintenance:**
 - Inspect gravel bag berms before, during, and after each rain event, and weekly throughout the rainy season.
 - Reshape or replace gravel bags, as needed.
 - Repair washouts or other damages, as needed.
 - Inspect gravel bag berms for sediment accumulations and remove sediments when accumulation reaches 1/3 of the berm height. Removed sediment shall be incorporated in the project.
 - Remove gravel bag berms when no longer needed. Remove sediment accumulations and clean, re-grade, and stabilize the area.

Common Failures:

- Gravel bag berms not placed along contour.
- Gravel bags may degrade over time.

ROCK OR BRUSH FILTER – SC-5

Application: Linear barriers and perimeter controls, such as rock or brush filters, are temporary measures that intercept sediment-laden runoff and filter or trap sediment or non-storm water flows behind the barrier. Linear barriers and perimeter controls are the last line of defense before stormwater leaves the site, and must be carefully selected, properly installed, and diligently maintained.

Rock or brush filters are temporary barriers composed of brush, wrapped in filter cloth and secured in place, or rock anchored in place. They are intended to intercept and filter sediment-laden stormwater runoff from the disturbed area, retaining the sediment and releasing water as sheet flow, at a reduced velocity. These barriers are designed for sheet flow, not concentrated flow, and must not be placed across a stream or channel.

Design Guidelines: Use for contributing drainage areas less than or equal to 5 acres. Topography and drainage patterns are important considerations in the design of the linear barriers. Barriers shall be placed along a contour, and it is important that barriers be properly installed and keyed into the soil to prevent undermining (i.e., flow passing under the barrier). Use along the perimeter of disturbed areas; near the toe of slopes that may be subject to flow and rill erosion; around temporary spoil areas; along streams and channels; and across mildly sloped construction roads (rock filter berms, only).

Filters require sufficient space for ponded water because they allow water to seep through slowly. They are not effective for diverting runoff. Rock filter berms may difficult to remove when construction is complete.

Materials/Equipment: Site-cleared brush, woven-wire fabric, and wooden stakes; or clean rock.

Construction Specifications/Installation:

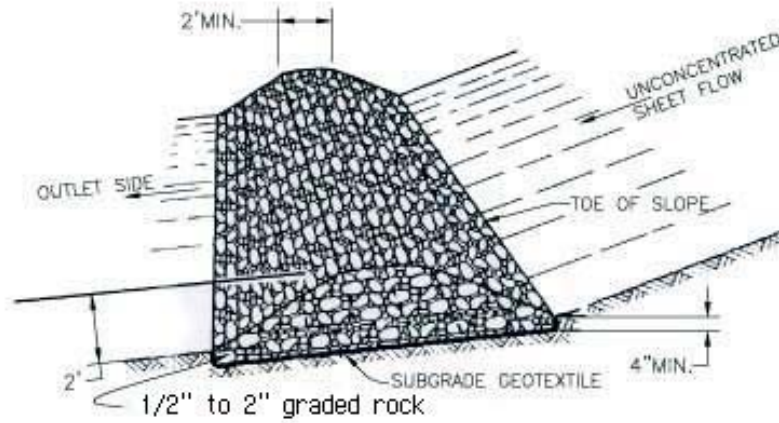
- Brush and rock filters shall be installed along a level contour.
- Provide adequate areas upstream of filter to accommodate ponding.
- Brush filters shall consist of site-cleared brush, or alternative material approved by engineer.
- Brush and rock filters shall be 3-5 feet in height and 5-15 feet in width at the base.
- Stakes: 1.5-inch x 1.5-inch wooden stakes, or metal stakes with equal holding capabilities.
- Woody fill: Woody debris shall be less than 6 inches in diameter. Install filter fabric over wood debris and anchor on the uphill side of slope in a 4-inch x 4-inch backfilled trench and anchor with stakes or sandbags on the downhill side of slope.
- Rock fill: open-graded rock, 0.75-5 inches for concentrated flow applications.
- Woven wire sheathing: 1 inch in diameter, hexagonal mesh, galvanized 20 gage (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights shall be 12 inches. Multiple berms shall be constructed every 300 feet on slopes less than 100H:5V (5%), every 200 feet on slopes between 100H:5V (5%) and 100H:10V (10%), and every 100 feet on slopes greater than 100H:10V (10%).
- Rock and brush filters as well as other sediment barriers shall be installed along the contour at intervals noted in the Sediment Fence BMP, Table SC-1.1.

Monitoring/Maintenance:

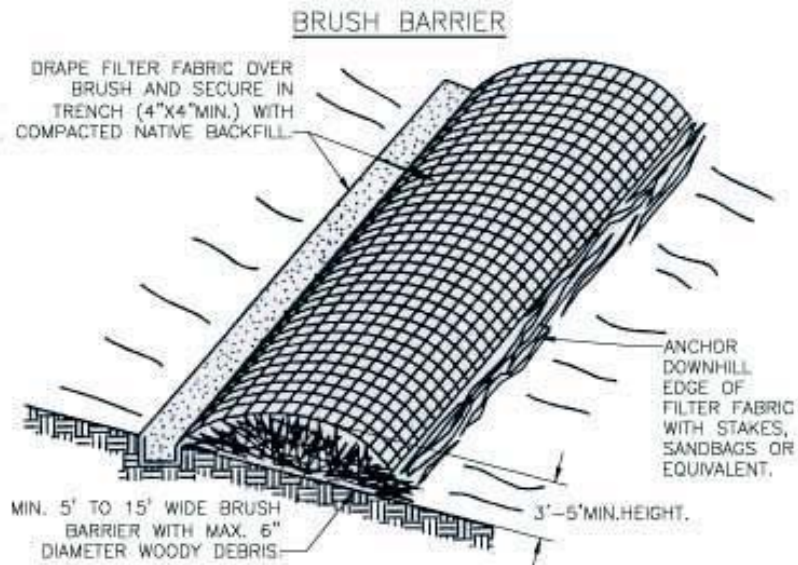
- Inspect berms before and after each significant rain event, and weekly throughout the rainy season. Reshape berms as needed and replace lost or dislodged rock, brush and/or filter fabric.
- Inspect for sediment accumulation, remove sediments when depth reaches 1/3 of the berm height or 12 inches, whichever occurs first.
- Filter berms shall be removed upon completion of construction activities.

Common Failures:

- Filter material may become clogged.
- Brush filter will decompose over time.



FILTER BERM



NOTES:

1. DIRECT THE OUTLET SIDE OF THE ROCK FILTER BERM/DAMS ONTO A STABILIZED AREA, SUCH AS VEGETATION AND OR ROCK.
2. EMBED A MIN. OF 4" INTO THE EXISTING GROUND/EMBANKMENT.
3. USE 3:1 OR FLATTER SIDE SLOPES. WITHIN THE SAFETY CLEAR ZONE, USE 6:1 OR FLATTER SIDE SLOPES.

FILTER BERMS
ROCK/BRUSH

SC-5

COMPOST BERMS AND SOCKS – SC-6

Application: A compost filter berm is a trapezoidal berm applied by a blower, and a compost sock is compost material encased in mesh to form a tube/roll. Both techniques intercept sheet flow and pond runoff, allowing sediment to fall out of suspension, and often filtering sediment as well. Compost berms and socks provide an environmentally-sensitive and cost-effective alternative to sediment fence. Compost binds heavy metals and can break down hydrocarbons into carbon, salts and other innocuous compounds.

Design Guidelines: Topography and drainage patterns are important considerations in the design of the linear barriers. Barriers shall be placed on the same contour, and it is important that barriers be properly installed and keyed into the soil to prevent undermining (i.e., flow passing under the barrier). Compost filter berms and socks shall only be used at the base of slopes 2H:1V or less. Compost berm or socks are for use in areas with sheet flow only and shall not be placed across streams or channels. They do not require any special trenching, construction, or removal, unlike sediment fence or coir rolls.

Materials/Equipment: Composted organic matter, biodegradable mesh. Specialized equipment is required, such as mechanical compost spreaders. Compost shall have the following specifications:

- Compost needs to be stable and mature.
- Particle size: Compost shall consist of both large and small pieces for maximum filtration. Finer grades ($\frac{3}{8}$ - $\frac{1}{2}$ inch screened) are better for vegetation establishment, long term plant nutrients, and increased infiltration rates. Coarser grades (2-3 inch screened) are better for increased filtration, and are less likely to be dislodged by rainfall and runoff. For berms, the ratio of coarse and fine material shall be about 1:1. No particle shall be greater than 3 inches in diameter.
- The recommended moisture content ranges from 20-50%. Compost that is too dry is harder to apply, while that which is too wet is heavier and harder to transport. In Gresham, use compost with lower moisture content because it will absorb water.
- Organic matter content: The percentage of carbon based materials in finished compost shall range between 40-70%.
- The pH shall be between 5.0 and 8.5.
- Nitrogen Content: 0.5-2.0%.
- Compost shall have a minimum of soluble salts, as these can inhibit vegetation establishment. These levels shall be between 4.0 and 6.0 mmhos/cm.
- Compost must be weed and pesticide free, with manmade materials comprising less than 1%.

Construction Specifications/Installation:

- Compost berm sizing: On slopes of 3H:1V or less, install a compost berm 1-2 feet high and 2-4 feet wide at the base. For maximum filtration properties, install berm in a trapezoidal shape, with a 4-6 feet base, and a 2-3 feet wide top. Larger berms shall be used for steeper slopes. The basic rule of thumb is that the base should be twice the height of the berm.



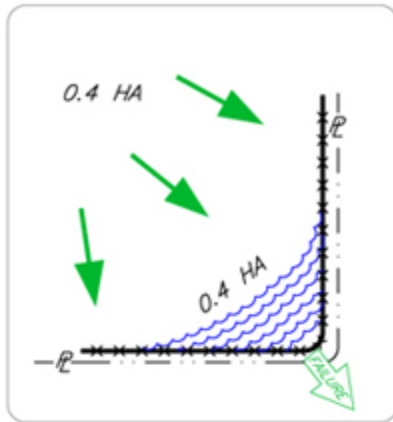
- Compost sock sizing: Typically, compost socks can handle the same water flow or slightly more than sediment fence. However, the installation technique is especially important for proper functioning. For most applications, a standard sediment fence replaced with a 12-inch compost sock.
 - Place on level contour so that sheet flow is perpendicular to the compost sock at the impact points. Do not place in areas of concentrated flow.
 - Compost socks shall be installed 5 feet or more from the toe of slopes to maximize space available for sediment deposition.
 - In order to prevent water flowing around the ends of compost socks, angle the ends upslope toward higher elevation.
- For perimeter control, compost berms and socks shall be placed on the contour. For irregular slopes or steep slopes, berms and socks shall be placed around the perimeter of affected areas using "smiles" and j-hooks (see BMP detail for an example). Do not place berms and socks where they cannot pond water. For steeper slopes, an additional berm or sock can be constructed on the top of the slope.
- For slope breaks, compost berms and socks shall be placed along the contour. See Sediment Fence BMP SC-1, Table SC-1.1 for spacing requirements.
- Compost berms and socks can be seeded during application. Do not cover seed with more than 2-4 inches of compost.
- Tackifiers may be applied to berms if needed to enhance performance.

Monitoring/Maintenance:

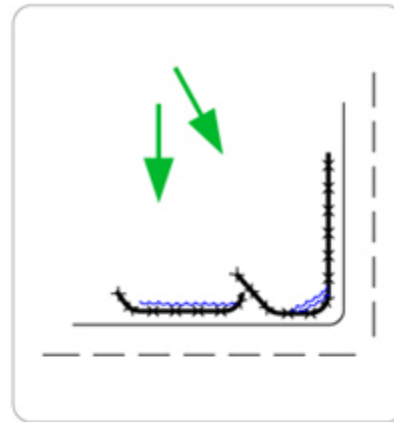
- Compost berms and socks shall be inspected after each storm event and reapplied if necessary.
- Sediment retained by the berm or sock shall be removed when it has reached 1/3 of the exposed height of the berm. Alternatively, the sediment and berm or sock can be stabilized with vegetation at the end of construction.
- Berms can be left on-site and seeded, or spread out in place as a soil enhancement.

Common Failures:

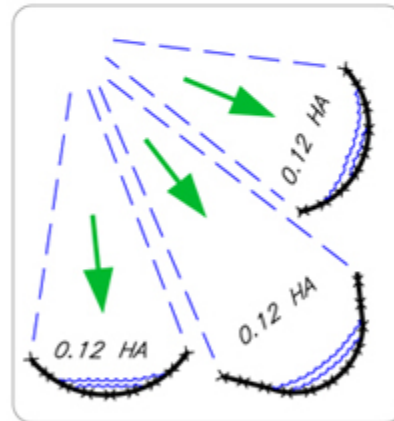
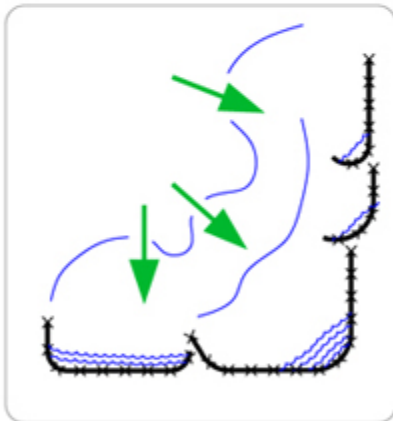
- Barrier not repaired after damage by heavy equipment.



Incorrect – Do Not layout “perimeter control” compost berms along property lines. All sediment laden runoff will concentrate and overwhelm the system.

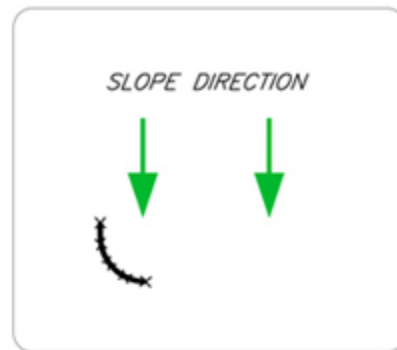


Correct – Install J-hooks

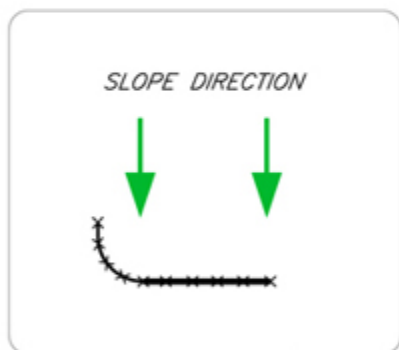


Discreet segments of compost berms, installed with J-hooks or ‘smiles’ will be much more effective.

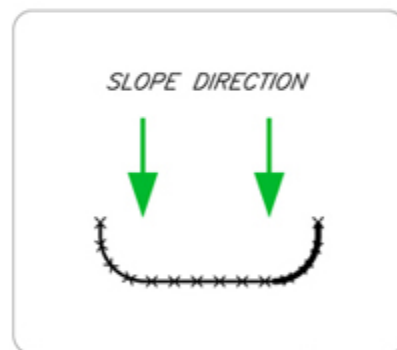
COMPOST BERM PLACEMENT FOR PERIMETER CONTROL



STEP 1 – CONSTRUCT LEG



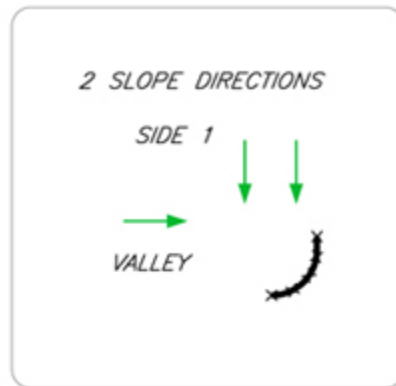
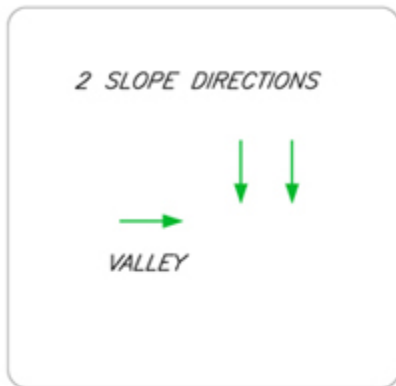
STEP 2 – CONSTRUCT DAM



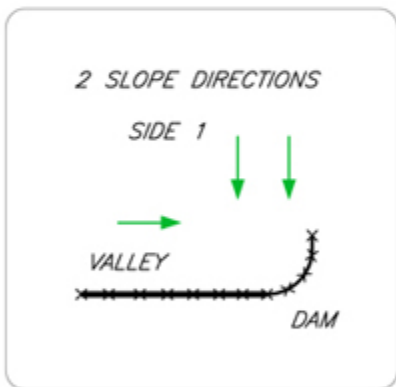
STEP 3 – CONSTRUCT LEG 2

INSTALLATION WITH J-HOOKS OR 'SMILES' INCREASE COMPOST BERM EFFICIENCY.

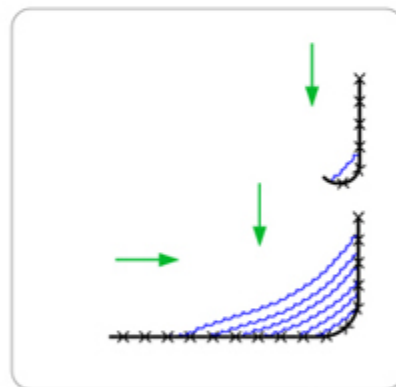
COMPOST BERM TYPICAL PLACEMENT—ONE SLOPE



STEP 1 – CONSTRUCT A DAM



STEP 2 – CONSTRUCT SIDE 2



STEP 3 – CONSTRUCT J-HOOKS
AS NEEDED

INSTALLATION WITH J-HOOKS WILL INCREASE COMPOST BERM EFFICIENCY
AND REDUCE EROSION-CAUSING FAILURES.

COMPOST BERM TYPICAL PLACEMENT-TWO SLOPES

FIBER ROLLS OR WATTLES – SC-7

Application: Fiber rolls are small, cylindrical barriers composed of biodegradable fibers encased in photodegradable open weave netting. They are primarily identified as a sediment control measure used for perimeter or inlet protection, and also as an erosion prevention technique when used as slope breaks by being placed along the contours of the slope and staked into place. Fiber rolls are porous and allow water to filter through them. They intercept runoff, reduce flow velocity, release runoff as sheet flow, and provide some sediment retention. Fiber rolls create a favorable environment for plant establishment by interrupting the slope length and trapping soil and moisture. Also see Live Fascines and Brush Wattles (EP-16).

Appropriate applications for fiber rolls are at, in, or along:

- The face of exposed and erodible slopes to shorten slope length.
- The top of exposed and erodible slopes to spread runoff as sheet flow.
- Grade breaks where the slope transitions to a steeper gradient.
- Drainage swales to slow flows.
- Streambanks to assist stabilization and revegetation.

Design Guidelines: Fiber rolls are placed and staked along the contour of newly constructed or disturbed slopes, in shallow trenches. Appropriate sites are slopes susceptible to sheet and rill erosion, slopes producing dry ravel, slopes susceptible to freeze/thaw activity, and slopes difficult to vegetate because of soil movement.

As a linear barrier and perimeter control, fiber rolls and wattles are designed for sheet flow, not concentrated flow, and shall not be placed across a stream or channel. As temporary slope interrupter devices, they trap sediment and moisture on slopes until vegetation can provide long-term stabilization.

As slope breaks, fiber rolls reduce slope length, capture sediment, and reduce soil creep and rill erosion on slopes until permanent vegetation can be established. Fiber rolls can capture organic matter, topsoil, seeds, and moisture to provide a stable medium for germination and growth.

Barriers shall properly installed by keying into the soil to prevent undermining (i.e., flow passing under the barrier).

- It is imperative, that a sufficient trench is constructed in which to place the roll. Without the trench, the roll will not function properly, runoff will scour underneath it, and trees or shrubs planted behind the roll will not have a stable environment in which to become established.
- Fiber rolls last for an average of two years, depending on the fiber and mesh used in manufacturing. This is an important factor to consider when planning for permanent slope stabilization.
- Fiber rolls can be staked with live stakes if the site conditions warrant. Moisture retained by the fiber roll will encourage live stakes to root.

Materials/Equipment: Fiber rolls are manufactured from biodegradable fibers (such as weed-free rice straw, coconut, or other approved material) that are wrapped in photo-degradable netting. They are approximately 8-20 inches in diameter and 25-30 feet long.

Construction Specifications/Installation:

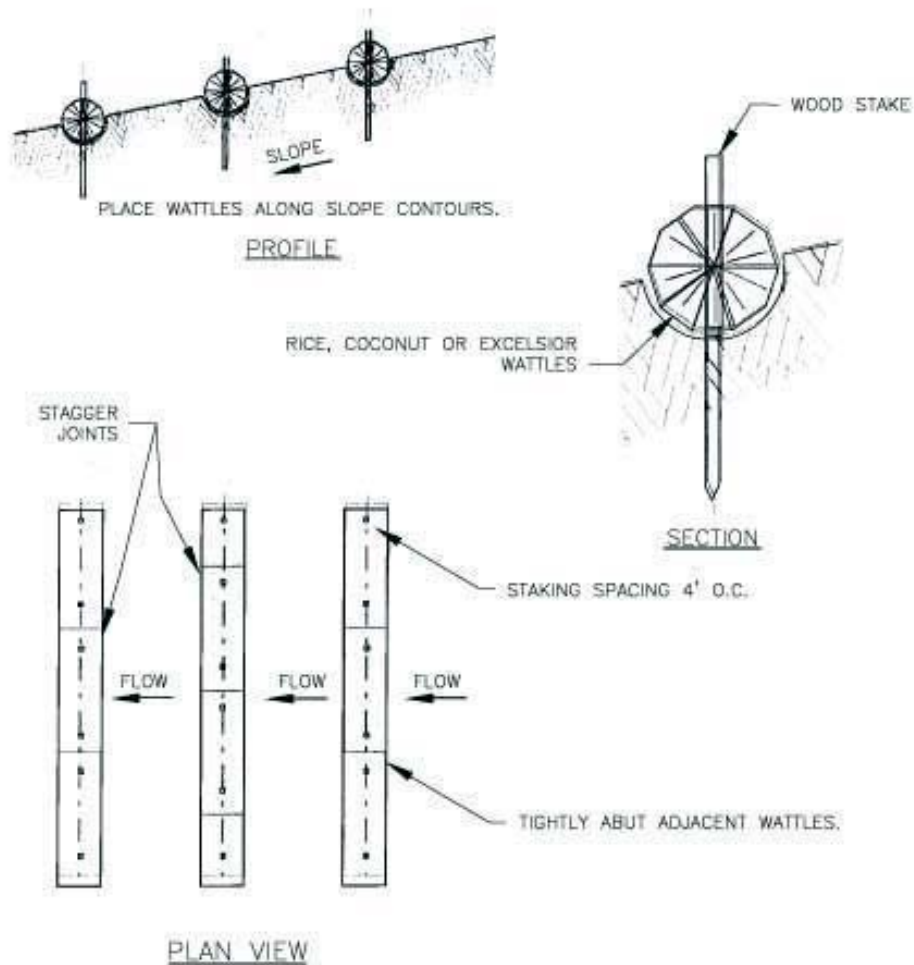
- The slope requires little preparation prior to the installation of fiber rolls or wattles. Rills and shallow gullies shall be smoothed as work progresses.
- Fiber rolls and wattles shall be installed along the contour and perpendicular to water movement.
- Dig shallow trenches across the slope and along the contour to place rolls. The trenches shall be deep enough to accommodate half the thickness of the roll. When the soil is loose or not compacted, the trench shall be deep enough to bury the roll 1/3 of its thickness because the ground will settle.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- For slope breaks, fiber rolls and wattles shall be spaced according to the Sediment Fence BMP (SC-1), Table SC-1.1.
- For bioengineering, fiber rolls should be placed 25-30 feet apart depending on the steepness of the slope. The steeper the slope, the closer together the trenches shall be.
- Place rolls or wattles tightly against the soil in the trench, fitting them snugly against the soil. Make sure no gaps exist between the soil and the roll or wattle.
- For willow or wooden stakes, use a straight bar to drive holes through the roll and into the soil. Drive the stakes through the prepared holes, and into the soil at least 12 inches. Leave only 1-2 inches of the stake exposed above roll. Install stakes at least every 4 feet along the length of the wattle. Additional stakes may be driven on the downslope side of the trenches on highly erosive or very steep slopes.

Monitoring/Maintenance:

- Inspect the rolls and the slopes after rain events.
- Repair any rills or gullies promptly and make sure the rolls are in contact with the soil.
- Reseed or replant vegetation, if necessary, until the slope is stabilized.

Common Failures:

- Rolls lose function after one or two seasons.
- If not installed properly with a sufficient trench, rolls may fail during the first rain event.
- Stakes may not hold on steep slopes with sandy soil.



NOTES:

1. STAKING SPECIFICATIONS:

- a. 1"x2" WOODEN STAKES
- b. ADDITIONAL STAKES MAY BE INSTALLED ON DOWNHILL SIDE OF WATTLES, ON STEEP SLOPE OR HIGHLY EROSION SOILS.

2. Space in accordance with Table SC1-1.

FIBER ROLLS/WATTLES

SC-7

STORM DRAIN INLET PROTECTION – SC-8

Application: Temporary inlet protection must be provided for all active inlets for the duration of construction to keep sediment, trash, and other construction-related pollutants out of the storm drain system.

Design Guidelines: Identify existing and/or planned on-site and adjacent storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine what the inlet types are and which method is appropriate to use. The specific types of BMPs are noted under Construction Specifications/Installation, below. BMPs shall be installed to properly to prevent sediment from entering the inlet.

Materials/Equipment: A variety of temporary inlet protection devices are available that are designed to be installed on soil, pavement, or inside the inlet, including: sediment insert bags; gravel bags, biobags, or bone bags; fiber rolls; block and gravel inlet protection; and filter fabric fence.

Construction Specifications/Installation:

Minimum specifications are provided on the Storm Drain Inlet Protection BMP details. The inlet protection Types 1-5 are designed to avoid most flooding. If a flooding problem occurs, modify the installed BMP to alleviate flooding. Do not remove the BMP to allow sediment-laden water to discharge to the storm drain.

Paved and Non-Paved Areas:

- Inlet Protection Type 1 – **Sediment Insert Bags** – The insert shall be installed per manufacturer's specifications. The Type 1 detail shows a Siltsack™ sediment insert bag. Storm drains with recessed curb inlets shall be blocked utilizing manufactured foam blocks to direct stormwater into the insert bag.
- Inlet Protection Type 2 – **Gravel bags, Biobags, or Bone Bags** – Bag barriers shall surround the entire inlet. Ensure there are no gaps between bags, and that the bags are in contact with the pavement or ground. Gravel bags shall be constructed utilizing material specifications provided in the Gravel Bag Berm BMP (SC-3). Sand bags shall not be used for inlet protection.
- Inlet Protection Type 3 – **Fiber Rolls** – The fiber roll is placed around the inlet, keyed, and anchored to the surface similar to the installation technique of the Fiber Rolls and Wattles BMP (SC-7). On impervious surfaces, use weighted or gravel-filled fiber rolls as specified by the manufacturer.
- Inlet Protection Type 4 – **Block and Gravel** – The inlet shall be surrounded by cinder blocks with only the center block openings lying horizontally and perpendicular to the flow. All other block openings shall be aligned vertically. Fine wire mesh shall be placed between the blocks and gravel. Gravel shall be clean drain rock between ½ and 1 inch in diameter.

Non-Paved Areas Only:

- Inlet Protection Type 5 - **Filter Fabric Fence** - The filter fabric fence shall completely surround the inlet and be installed as shown in the BMP detail with protection provided in the space between the sediment fence and the inlet as illustrated. Similar to constructing a sediment fence (SC-1), the bottom of the fabric shall be toed-in 6 inches. Do not place filter fabric underneath the inlet grate—it cannot be maintained or removed without the collected sediment falling into the drain.
- Alternative methods will be considered on a site-by-site basis based on site characteristics, and require approval by the City.

Monitoring/Maintenance:

- Inspect all inlet protection devices before and after every rain event and weekly at active construction sites. During extended rain events, inspect inlet protection devices at least every 24 hours.
- Inspect the storm drain inlet for bypassed material after severe storms during the rainy season.
- When the site is stabilized:
 - Bring all disturbed areas to final grade. Appropriately stabilize all bare areas.
 - Inlets and stormwater systems must be cleaned prior to project finalization.

Type 1 - Sediment Insert Bags

- Inspect bags for holes and gashes. Replace as necessary.
- Clean and/or replace bags when capacity has been reduced by 50%, or bag is 1/3 full.

Type 2 - Bag Barriers

- Inspect bags for holes, gashes, and snags.
- Remove the sediment from behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project or disposed of properly.
- Check gravel bags for proper arrangement and displacement.

Type 3 - Fiber Rolls

- Use weighted or gravel-filled fiber rolls on impervious surfaces. Check that fiber rolls are in good contact with the surface without gaps or preferential flow paths.
- Check fiber roll for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project or disposed of properly.

Type 4 - Block and Gravel

- Inspect for clogging and flooding.
- Remove and replace rock when flow becomes restricted.

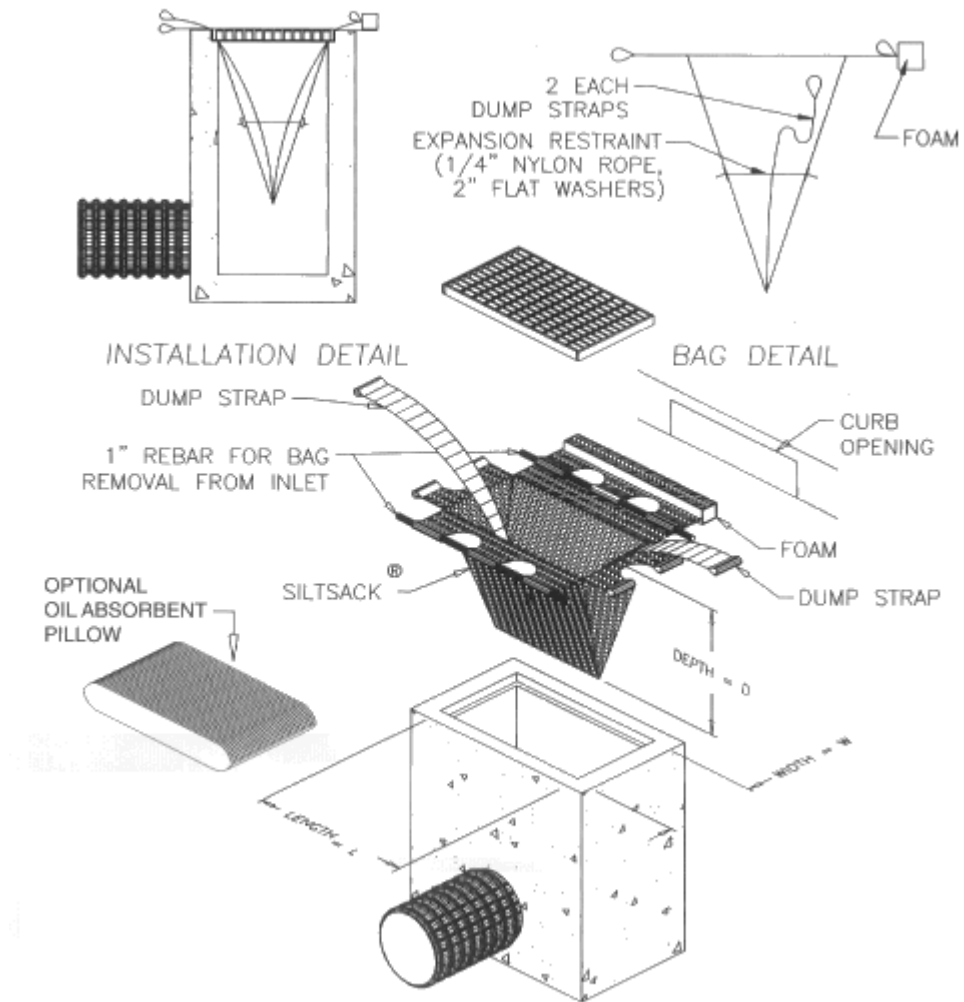
Type 5 - Filter Fabric Fence

- Make sure the toe of the fabric is buried 6 inches and the backfill is compacted.
- Make sure the stakes are securely driven in the ground and are structurally sound (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.
- Replace or clean the fabric when the fabric becomes clogged with sediment. Make sure the fabric does not have any holes or tears. Repair or replace fabric, as needed.
- At a minimum, remove the sediment behind the fabric fence when accumulation reaches 1/3 the height of the fence. Removed sediment shall be incorporated in the project or disposed of properly.

Common Failures:

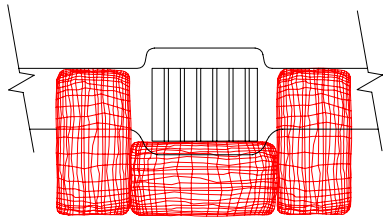
- Trampling by equipment and traffic.
- Inadequate maintenance.

Typical Siltsack® Construction

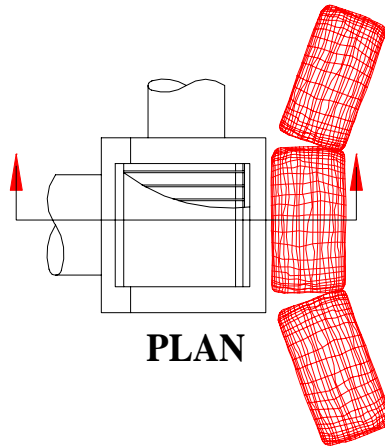


INLET PROTECTION – TYPE 1
SEDIMENT INSERT BAG

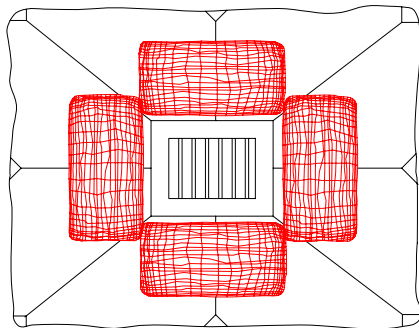
SC-8



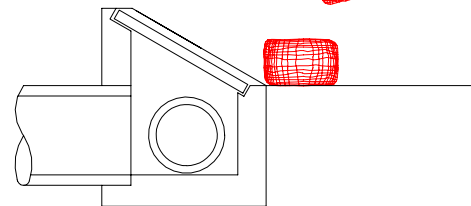
CATCH BASIN



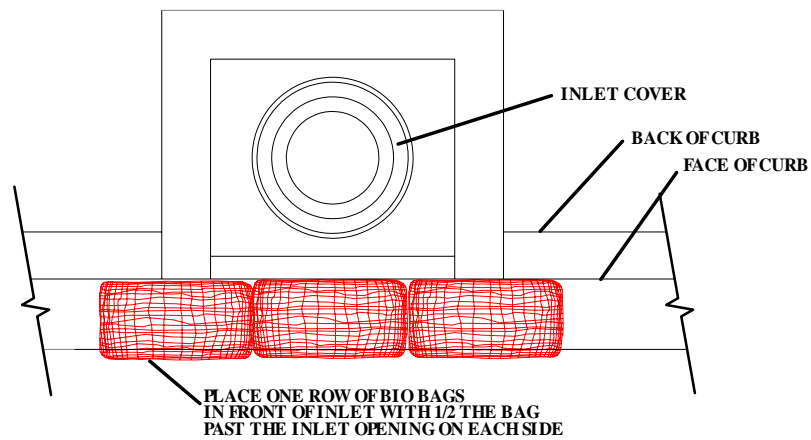
PLAN



AREA DRAIN



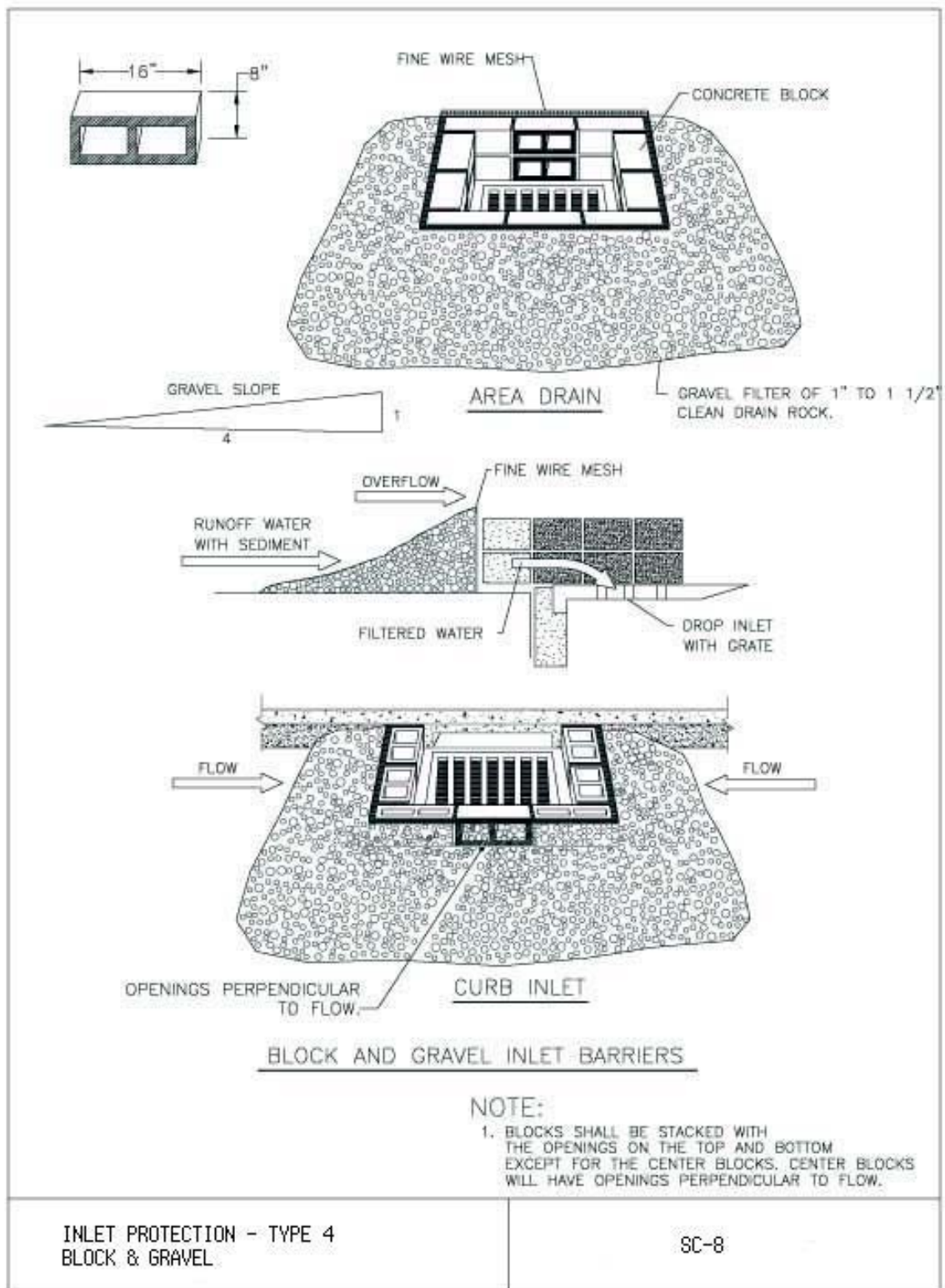
DITCH INLET

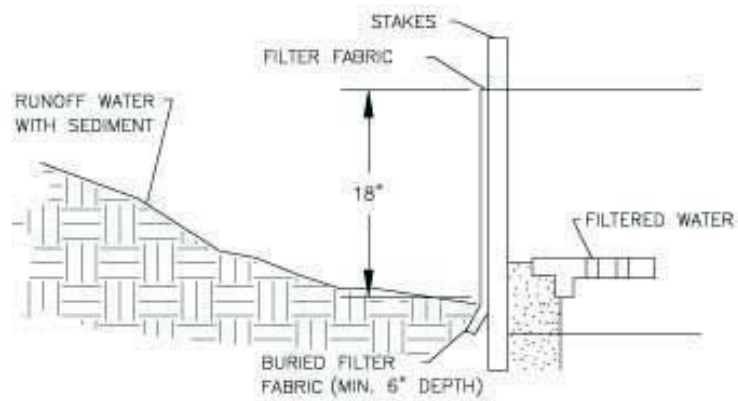
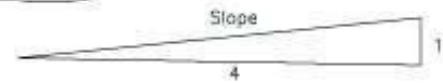
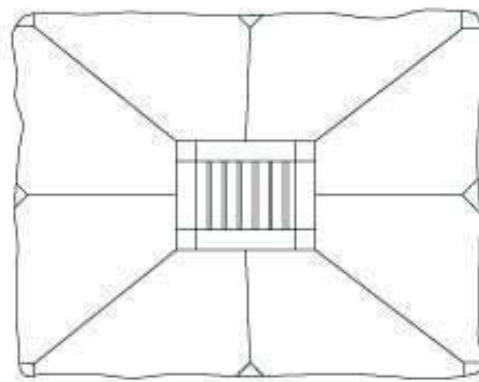
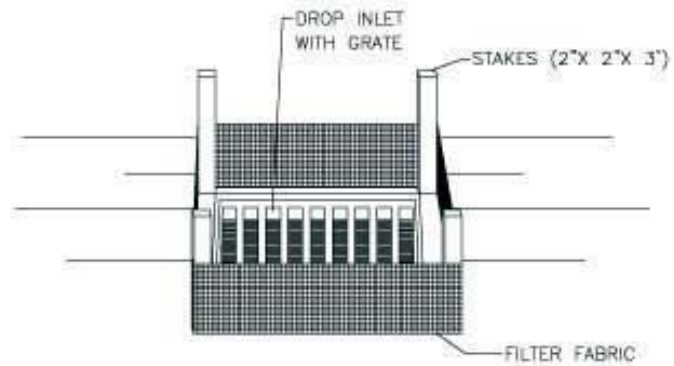


**CURB INLET CATCH BASIN
BIO BAG INLET PROTECTION**

NTS

INLET PROTECTION – TYPES 2 & 3 GRAVEL BAGS, FIBER ROLLS & BONE BAGS	SC-8
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PROFILE

INLET PROTECTION - TYPE 5
FILTER FABRIC FENCE

SC-8

TEMPORARY SEDIMENT BASIN – SC-9

Application: A sediment basin is a temporary basin with a controlled release structure, formed by excavating or constructing an earthen embankment across a waterway or low drainage area. Sediment basins may be placed where sediment laden storm water may enter a storm drain or watercourse, and around and/or up-slope from storm drain inlet protection measures. Temporary sediment traps and basins are engineered temporary hydraulic controls that function by modifying the storm runoff hydrograph by: excavating below grade or by constructing an embankment to retain stormwater; capturing and detaining sediment-laden stormwater runoff from the site, thus providing an opportunity for suspended soil particles to gravitationally settle out; and providing a temporary storage device for the captured sediment.

Design Guidelines: All basins shall have an outlet device to release the water in a controlled manner and a stabilized emergency spillway for overflow. Outlet devices shall be sized to empty the basin within 48 hours. Basins shall be sized to retain 3,600 cubic feet per acre for the contributing watershed. Additional capacity shall be added to store accumulated sediment between maintenance clean-outs. All engineered structures must be designed by a professional engineer licensed in the State of Oregon.

Sediment basins are typically not recommended for sites with fine-grained soils such as silts and clays. Because these soils will stay in suspension for a long time, it may not be feasible to hold the water long enough for fine-grained suspended sediment to settle out of suspension without additional treatment (i.e., flocculants; vegetation). The use of flocculants will be considered by the City on a site-by-site basis. Vegetation is required for sediment ponds designed as a permanent detention structure. Vegetation may be required on temporary ponds.

The removal efficiency of sediment basins can be enhanced by using baffles, skimmers, or other devices to lengthen the flow path and/or improve the removal of suspended particles. The placement of baffles in a sediment basin creates a longer flow path through the basin, resulting in a longer holding time and increased potential for settling particulates. A skimmer is an alternative to slotted riser outlet pipes. It is a device that is attached to the sediment basin outlet and floats on the water surface above the settling zone. The skimmer has a designed orifice size that drains water out of the pond at a specified rate.

The basin configuration also has an effect on sediment performance. To improve the sediment trapping efficiency of the basin, the effective flow length shall be twice the effective width. This basin shape may be attained by optimal site selection or by the use of baffles. The inlet shall be at the opposite end from the outlet, either by design or by the use of baffles.

Materials/Equipment: Culvert, riser, skimmer, excavation equipment, and flocculants, as required.

Construction Specifications/Installation: The sediment basin shall follow one of the four design options summarized below:

- Option 1: A sediment basin designed pursuant to local ordinance provided that the design efficiency is as protective, or more protective of water quality than Option No. 3.
- Option 2: A sediment basin designed with a minimum capacity of 3,600 cubic feet of storage per acre of disturbed land in a watershed equivalent to or more efficient than Option No. 3.
- Option 3: A sediment basin designed using the following equation:

$$(V) = 1.2Q/V_{SED}$$

Where:

V = settling zone volume

Q = flow rate based on peak discharge from a specified design storm (where Q =

CiA)

V_{SED} = settling velocity of the design soil particle

Option 4: A basin designed using an equivalent surface area design equation, equivalent to or more efficient than Option No. 3.

The following specifications shall apply to all four options:

- In accordance with the requirements of the NPDES 1200-C General Permit, all sediment basins must be designed by a professional engineer licensed in Oregon.
- Construct the basin by excavating or building an embankment before any clearing or grading work begins.
- Areas under the embankment and any structural works shall be cleared, grubbed and stripped of any vegetation and rootmats as shown on the grading plan.
- A cut-off trench shall be excavated along the centerline of the earth fill embankments. The minimum depth shall be 2 feet. The cut-off trench shall extend up both abutments to the spillway elevation.
- Fill material for the embankment shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks or other objectionable material, and sufficiently moist for compaction.
- Fill material shall be placed in 6-inch lifts, continuous layers over the entire length of the fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of each layer of the fill is traversed by at least one wheel or tread track of the equipment, or by the use of a compactor.
- The embankment shall be constructed to an elevation of 10% higher than the design height to allow for settlement if compaction is achieved with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than 5%. The basin shall have means for dewatering within 7 days following a storm event.
- The principal spillway riser shall be securely attached to the discharge pipe by welding all around. All connections shall be watertight. A trash rack shall be installed on the top of the riser to prevent clogging of the discharge pipe.
- The pipe and riser shall be placed on a firm, smooth soil foundation. The connection between the riser and the riser base shall be watertight. Pervious materials such as sand, gravel or crushed stone shall not be used as backfill around the pipe or anti-seep collars.
- The fill material around the pipe spillway shall be placed in 4-inch layers and compacted under the shoulders and around the pipe to at least the same density as the adjacent embankment. A minimum of 2 feet of compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.
- Steel base plates shall have at least 2 ½ feet of compacted earth, stone or gravel over them to prevent flotation.
- The emergency spillway shall not be installed in fill. Elevations, design width, and entrance and exit channel slopes are critical to the successful operation of the emergency spillway.
- If used, baffles shall be constructed of 4-inch by 4-inch posts, and 4-foot by 8-foot, ½-inch thick, exterior plywood. The posts shall be set at least 3 feet into the ground, no further apart than 8 feet, center to center, and shall reach a height 6 inches below the riser crest elevation. Alternatively, earthen berms, metal sheeting, or other methods may be used after approval by the City.

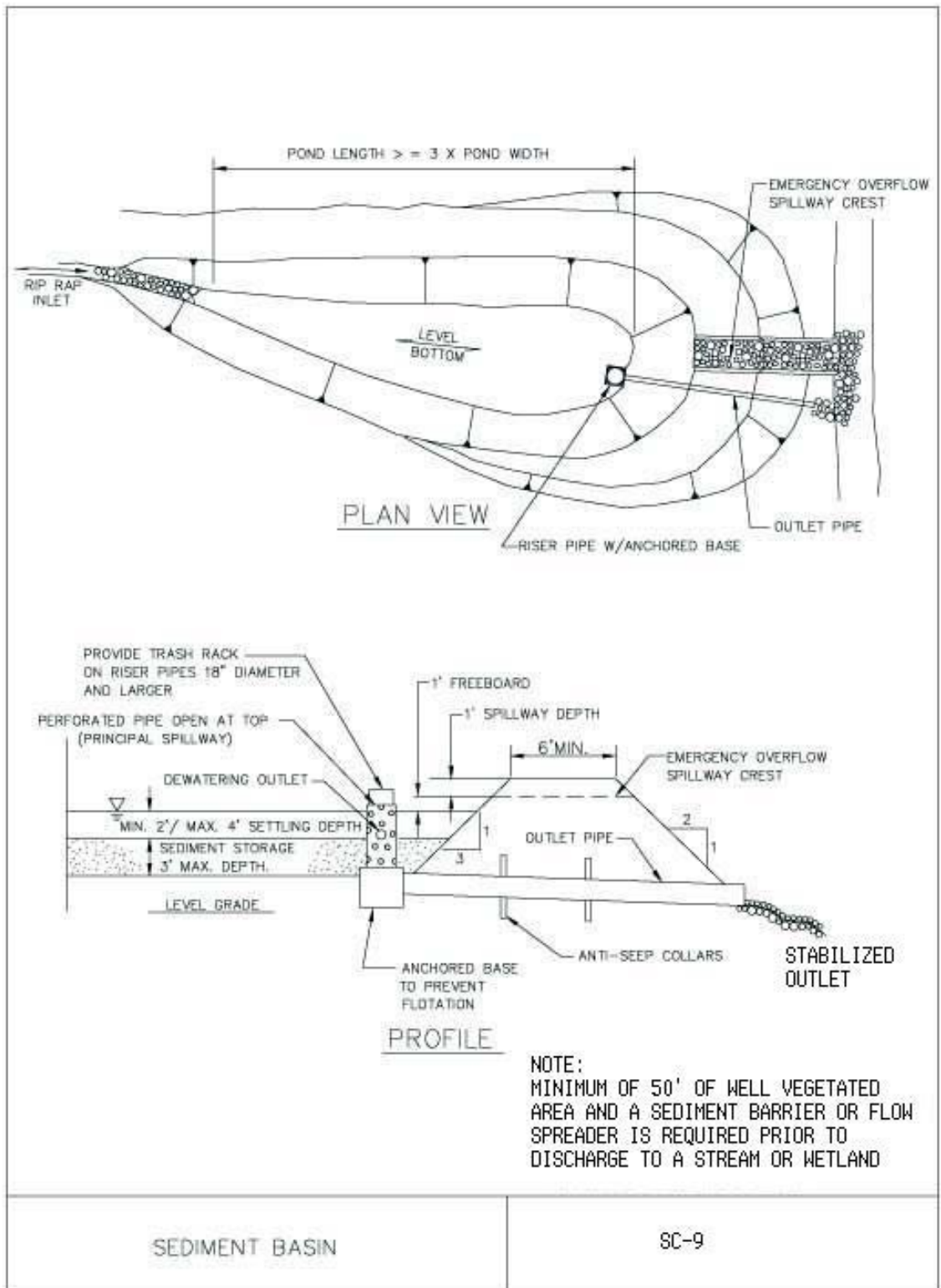
- The embankment and emergency spillway shall be stabilized with vegetation immediately following construction. The outflow shall be provided with outlet protection to prevent erosion and scour of the embankment and channel.
- Construction operations shall be carried out in such a manner that erosion and water pollution will be minimized.
- City and state requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.
- Flocculants may be added to the water in a sediment basin to increase the suspended sediment settling rate. Accepted flocculants include gypsum (a natural mineral product) and chitosan (a shellfish product). Other materials will be considered by the City and approved on a site-by-site basis. Manufacturers' recommendations shall be followed regarding rates of application and care shall be taken to avoid the release of flocculants from the basin.
- Electrocoagulation may be used to remove suspended solids and other contaminants from storm water runoff. It is a process whereby a controlled electrical current is passed through the water, which causes the suspended particulates to become charged and bond together to form larger masses that settle to the bottom. This process is effective on any size of suspended solids, including submicron particles, and is typically combined with filtration to enhance effectiveness.

Monitoring/Maintenance:

- All sediment traps require continued maintenance to function properly. Excess sediment shall be removed to ensure basin capacity and trap efficiency.
- Inspect before, during, and after each rain event.
- All damage caused by soil erosion or construction equipment shall be repaired before the end of each working day.
- Sediment basins must be cleaned out when the sediment storage zone is half full. Sediment removed from basins must be placed, compacted, and stabilized to avoid erosion and re-mobilization. The sediment shall not be deposited downstream from the embankment, or in or adjacent to a stream or floodplain. If there is a potential for the sediment to be contaminated, it must be tested and disposed of properly.
- When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposit shall be leveled or otherwise disposed of in accordance with the approved Plan.

Common Failures:

- Inadequate sizing.



CONSTRUCTION ENTRANCE / EXIT TRACKING CONTROLS – SC-10

Application: Tracking controls reduce offsite tracking of sediment and other pollutants by providing a stabilized surface at defined construction site entrances and exits. Also, they include sweeping or vacuuming to prevent sediment or other materials from entering a storm drain.

Design Guidelines: Stabilized entrances shall be implemented for all construction projects. Sweeping or vacuuming shall be implemented when sediment is tracked from the project site to public or private paved roads, typically near exit locations.

Materials/Equipment: Properly-sized aggregate and geotextile fabric.

Construction Specifications/Installation:

Stabilized Construction Entrances and Exits

- Limit the points of entrance/exit to the construction site by designating combination or single purpose entrances and exits. Require all employees, subcontractors and others to use them. Limit speed of vehicles to control dust. Clearly mark entrances and exits with appropriate signage.
- Locate construction entrances and exits to limit sediment leaving the site and to provide for maximum utility by all construction vehicles. Avoid entrances at steep grades or at curves in public roads.
- Grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Design the stabilized entrance/exit to support heaviest vehicles and equipment that will use it.
- The length of the pad shall not be less than 50 feet long and long enough for at least 4 to 5 wheel rotations of the largest vehicle or equipment at the site.
- The width of the pad shall not be less than the full width of all points of ingress or egress and shall not be less than 20 feet wide.
- The thickness of the pad shall not be less than 8 inches
- The aggregate size for construction of the pad shall be 3-6 inch stone. However, $\frac{3}{4}$ inch minus aggregate is allowable for single-family and duplex construction entrances. Place the gravel to the specific grade and dimensions shown on the plans and smooth it.
- Geotextile fabric is required for stability under the aggregate for all construction entrances, except single-family and duplex projects.
- All sediment spilled, dropped, washed, or tracked onto public rights-of-way shall be removed as soon as possible by hand sweeping, mechanized sweeper, or vacuum. Washing of sediment from the public right-of-way shall be prohibited.
- When off-site tracking cannot be controlled, wheels shall be cleaned to remove sediment before exiting to public rights-of-way (see Tire Wash, SC-11).
- All sediment shall be reduced or prevented from entering any storm drain, ditch, or watercourse through use of sediment fence, gravel bags, sediment barriers, or other approved methods.

Entrance with Shaker Plates

- The use of constructed or manufactured steel plates with ribs (e.g., shaker/rumble plates, corrugated steel plates) for entrance/exit access is allowable. Incorporate with a stabilized construction entrance/exit.
- Construct on level ground when possible, on a coarse (6-3 inch) aggregate pad. Geotextile fabric shall be placed below the aggregate.
- Install constructed or manufactured steel plates with ribs at the entrance/exit in addition to the aggregate.

- Steel shaker plates shall be designed and constructed/manufactured for anticipated traffic loads.

Street Sweeping and Vacuum Sweeping

- Inspect any areas of potential sediment tracking daily.
- Visible sediment tracking shall be swept or vacuumed daily and more often as necessary. Manual sweeping is appropriate for small jobs.
- For larger projects, use mechanical broom or vacuum sweepers that collect and contain removed sediment and material.
- If not mixed with debris or trash, incorporate the removed sediment back into the project or dispose of it at an approved disposal site.

Monitoring/Maintenance:

Stabilized Construction Entrance

- Inspect routinely for damage and assess effectiveness. Repair if access is clogged with sediment.
- Where tracking has occurred on roadways, sweeping shall be conducted the same day. Water shall not be used to wash sediment off the streets it can be captured and disposed of properly (i.e., vacuum sweeper).
- Keep all temporary roadway ditches clear.
- The entrance shall be maintained in a condition that will reduce or prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand, and repair and/or maintenance of any measures used to trap sediment.
- Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. Replace gravel material when surface voids are visible.
- After each rainfall, inspect all gravel construction entrances and clean, as necessary.
- Remove all objectionable materials or sediments spilled, washed, or tracked onto public roadways immediately or as soon as practicable.

Street Sweeping and Vacuuming

Inspect entrance and exit points daily and sweep tracked sediment as needed.

Be careful when handling any unknown substance or any object that may be potentially hazardous.

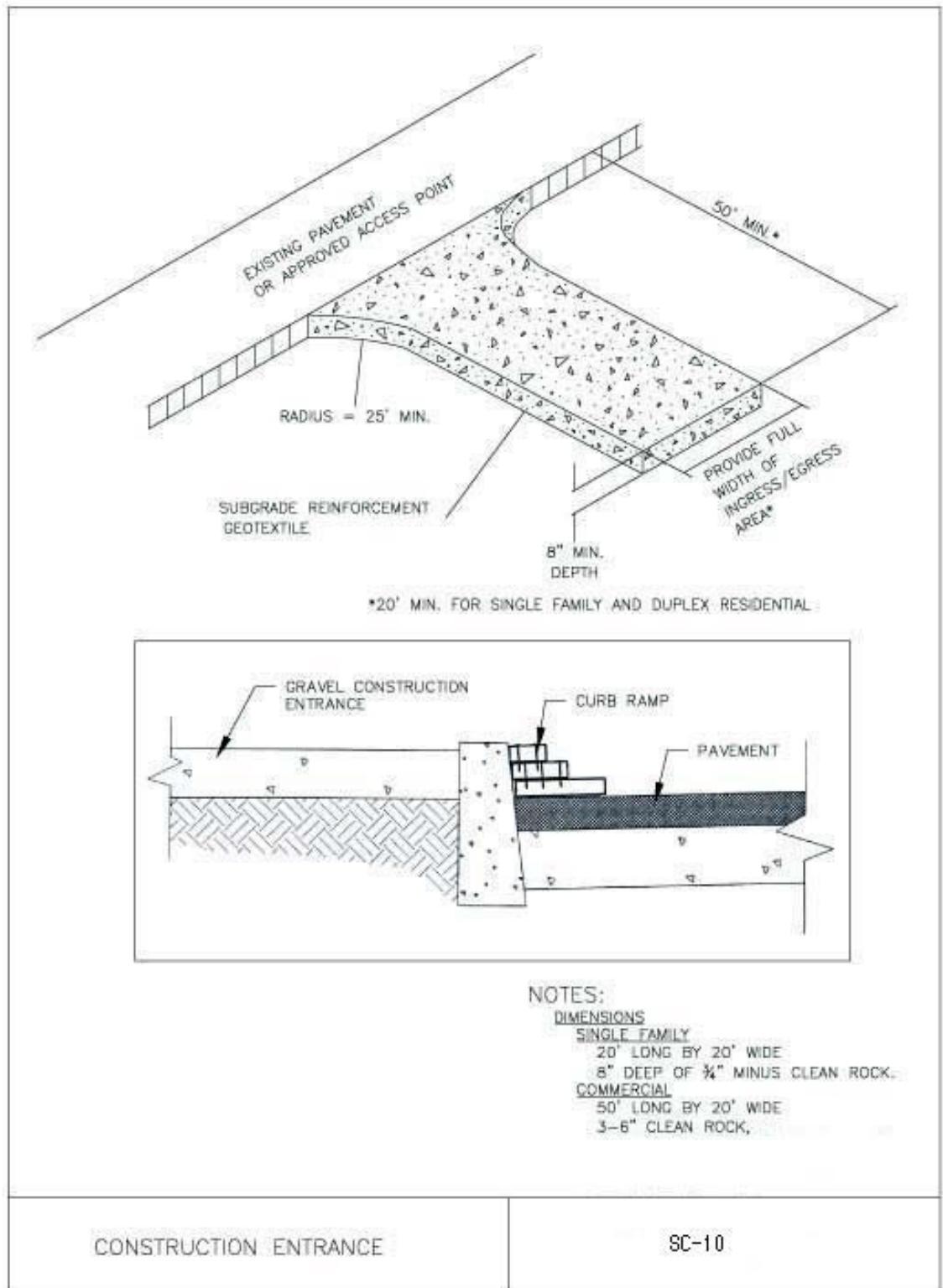
After sweeping is finished, properly dispose of sweeper wastes.

All sediment spilled, dropped, washed, or tracked onto public rights-of-way must be removed as soon as possible, and at least daily. Visible sediment tracking shall be swept or vacuumed as needed. Manual sweeping is appropriate for small jobs. For larger projects, use mechanical broom or vacuum sweepers that collect and contain removed sediment and material. Washing of sediment from public rights-of-way shall be prohibited. If not mixed with debris or trash, the removed sediment may be used on the project site or disposed of at an approved disposal site.

Common Failures:

Failure to outslope runoff to controlled detention area.

Lack of maintenance.



TIRE WASH – SC-11

Application: When off-site tracking cannot be controlled, wheels shall be cleaned to remove sediment prior to exiting to public rights-of-way. The tire wash may be a drive-through facility, or a hose and wash pad.

Design Guidelines: Tire washes may be either Manual/Hose or Temporary Drive-Through. All employees, subcontractors, and others that leave the site with mud-caked tires or under-carriages must use the wheel wash facility. The wheel wash, which should be incorporated with a stabilized construction entrance, must be designed and constructed for anticipated traffic loads.

Materials/Equipment: Water supply, crushed rock, corrugated steel panels, and filter fabric.

Construction Specifications/Installation:

- Incorporate with Construction Entrance/Exit Tracking Controls (SC-10).

Manual/Hose Tire Wash

- Construct on level ground when possible, and on a pad of coarse (3-6 inch) aggregate. A geotextile fabric shall be placed below the aggregate.
- Tire wash shall be designed and constructed/manufactured for anticipated traffic loads.
- Drainage shall be conveyed from the wash area to a sediment trapping device. The drainage ditch shall be of sufficient grade, width, and depth to carry runoff from the wash.
- Require that all employees, subcontractors, and others who leave the site with mud-caked tires or under-carriages use the wash facility.

Temporary Drive-Through Tire Wash

- Minimum dimensions: 40 feet long by 12 feet wide by 1.5 feet deep. The minimum length includes ingress and egress from the sump.
- The aggregate size for construction of the pad shall be 3-6 inch stone. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.
- The thickness of the pad shall not be less than 8 inches. Use geotextile fabric under the gravel to improve stability of the foundation.
- Alternatively, install a 3-inch asphalt lift over a stable roadway base with the same dimensions as above.
- The run out pad shall extend 50 feet past the egress ramp and drain back into a sump or suitable collection and treatment facility.
- Install fencing, as necessary, to manage vehicle traffic.

Monitoring/Maintenance:

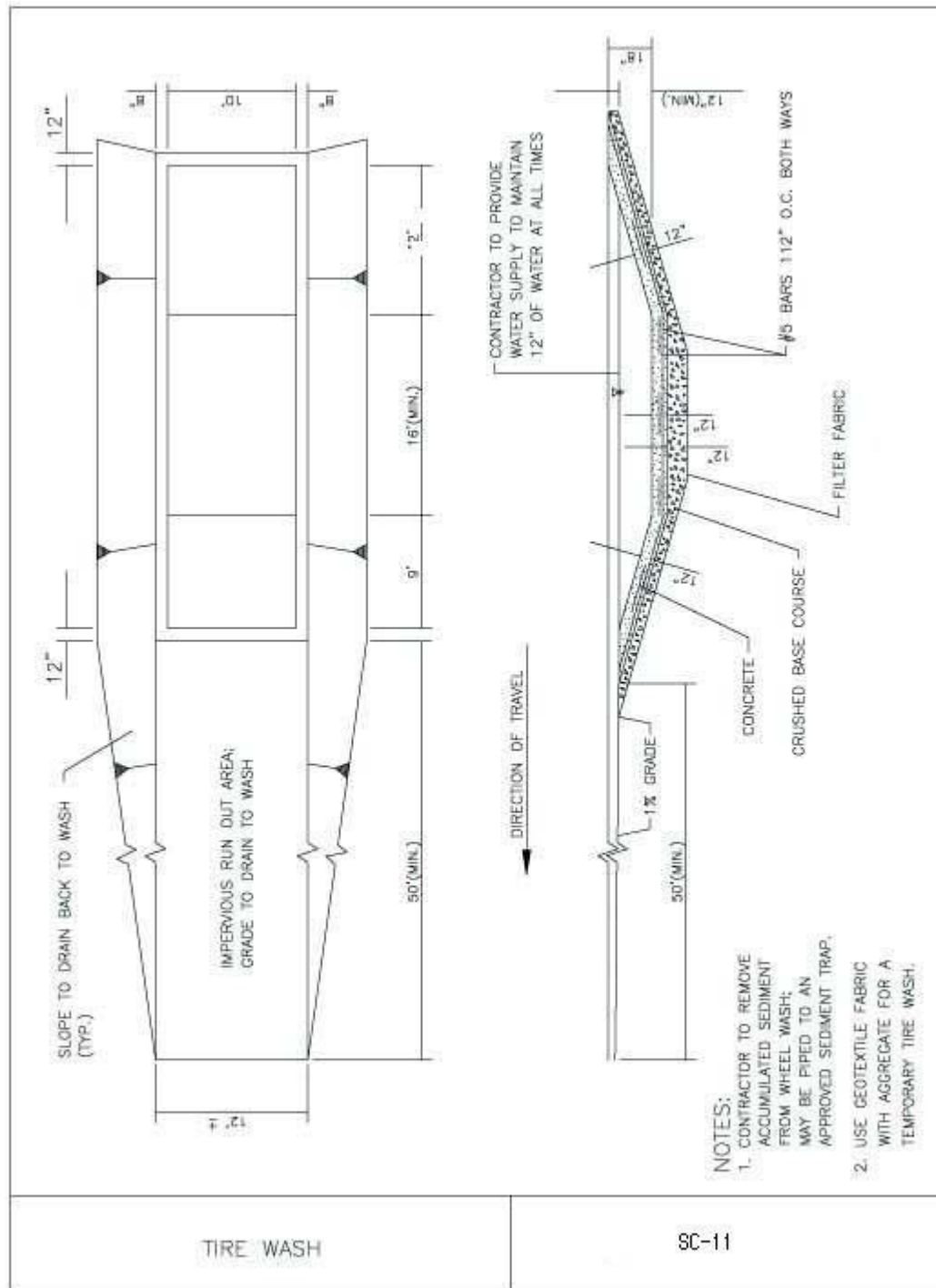
Manual/Hose Tire Wash

- Remove accumulated sediment in tire wash and sediment trap to maintain system performance.
- Inspect routinely for damage. Clean or replace rock, as needed.

Temporary Drive-Through Tire Wash

- Inspect routinely to assess the water levels within the sump, the depth of accumulated sediment, and identify any areas that require maintenance.

- Remove accumulated sediment from the tire wash facility to maintain tire wash sump depth. Sediment may be pumped, piped, or vacuumed to a suitable collection and treatment facility.
- Clean or replace rock when clogged with sediment and re-grade, as needed.
- Maintain the run-out pad as necessary to prevent sediment accumulation.
- Immediately remove any rock that is carried from the pad to the roadway.
- Ensure that wash water drainage, collection, and treatment is functioning.



UNDERCUT LOTS/SIDEWALK SUBGRADES – SC-12

Application: Undercut lots or sidewalk subgrades are linear drainage barriers that provide an effective sediment filtration and retention area behind the curb.

Design Guidelines: Topography and drainage patterns are important considerations in the design of the under cut lots as linear barriers.

Materials/Equipment: Concrete curb or pavement, sub-base material, and excavation equipment.

Construction Specifications/Installation:

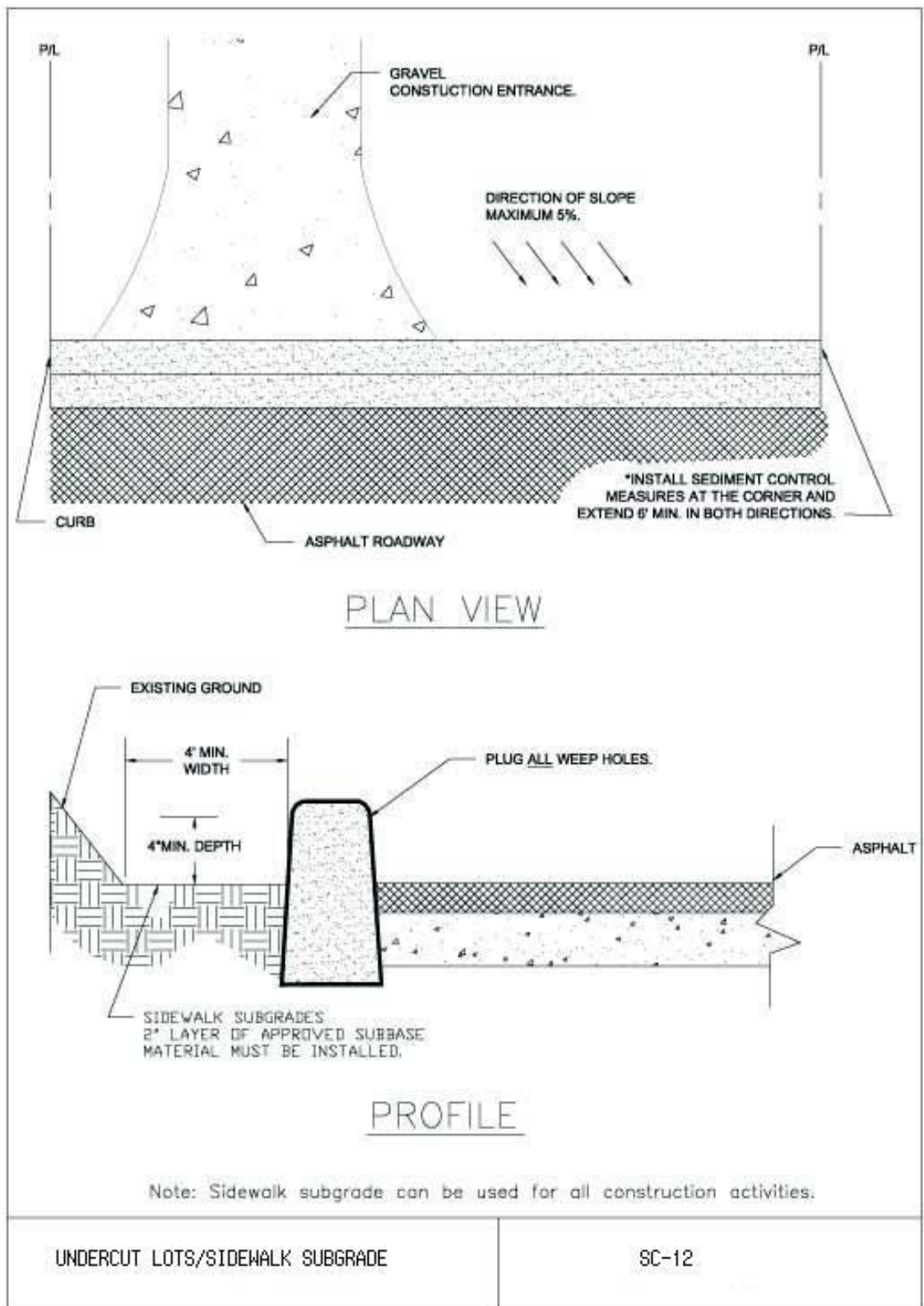
- Cut back soil from curb 2-4 inches deep and 4 feet wide to form a temporary sediment trap.
- Place a 2-inch layer of aggregate sub-base.
- Weep holes in curb must be plugged.
- If sidewalk is to be poured prior to site stabilization, alternative sediment barriers must be installed.

Monitoring/Maintenance:

- Inspect weekly, and prior to and after rain events.
- Maintain as needed.
- Remove accumulated sediment and replace aggregate when filtering capacity is reduced by 50 percent or aggregate is clogged with sediment.

Common Failures:

- Lack of maintenance.



TEMPORARY SEDIMENT TRAP – SC-13

Application: A sediment trap consists of a small, temporary area engineered for ponding water. Sediment-laden water is trapped by a rock weir or perforated riser pipe at the outlet. Sediment traps are excavated below grade or constructed above by using an embankment. Stormwater runoff is captured and detained in the trap, providing the opportunity for suspended soil particles to gravitationally settle out and for temporary sediment storage.

Design Guidelines: A sediment trap is designed to remove sediment from runoff by holding a volume of water for a length of time, allowing particles 0.0008 inch and larger to settle out. Sediment traps should be used as a last line of defense and never as a stand-alone measure.

Sediment basins are recommended for sites with coarse-grained soil. Fine-grained silts and clays will stay in suspension too long, and it may not be feasible to hold the water long enough for fine-grained suspended sediment to settle out of suspension (without treatment by flocculants or vegetation).

Materials/Equipment: Rock, aggregate, and geotextile fabric.

Construction Specifications/Installation:

- Construct prior to upslope clearing and grading.
- Locate in a low area where the trap will intercept all or most of the runoff from the disturbed area before it enters a waterway.
- Provide for temporary diversion swales (RC-3) or dikes (RC-4) to collect and divert water to the trap.
- Sediment storage volume can be calculated using the RUSLE, assuming a minimum one-year sediment accumulation period for design purposes. (To convert tons of sediment to cubic-foot volume, assume 0.05 ton of sediment per cubic foot.)
- Determine the bottom surface area of the sediment trap using the calculated sediment volume and the maximum 1½ foot depth for sediment storage.
- Determine the total trap dimensions by adding an additional 2 feet of depth for settling volume (before overtopping of spillway) above the sediment storage volume, while not exceeding 3H:1V side slopes.
- Design the trap with a level bottom and 3H:1V or flatter side slopes.
- Form the trap by excavation or by construction of compacted embankment. If the trap is formed by embankment, dam safety regulations may apply to embankment heights exceeding 5 feet. The embankment should be stabilized using a cover method such as seeding, mulching, or matting.
- Evaluate the release areas on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff.

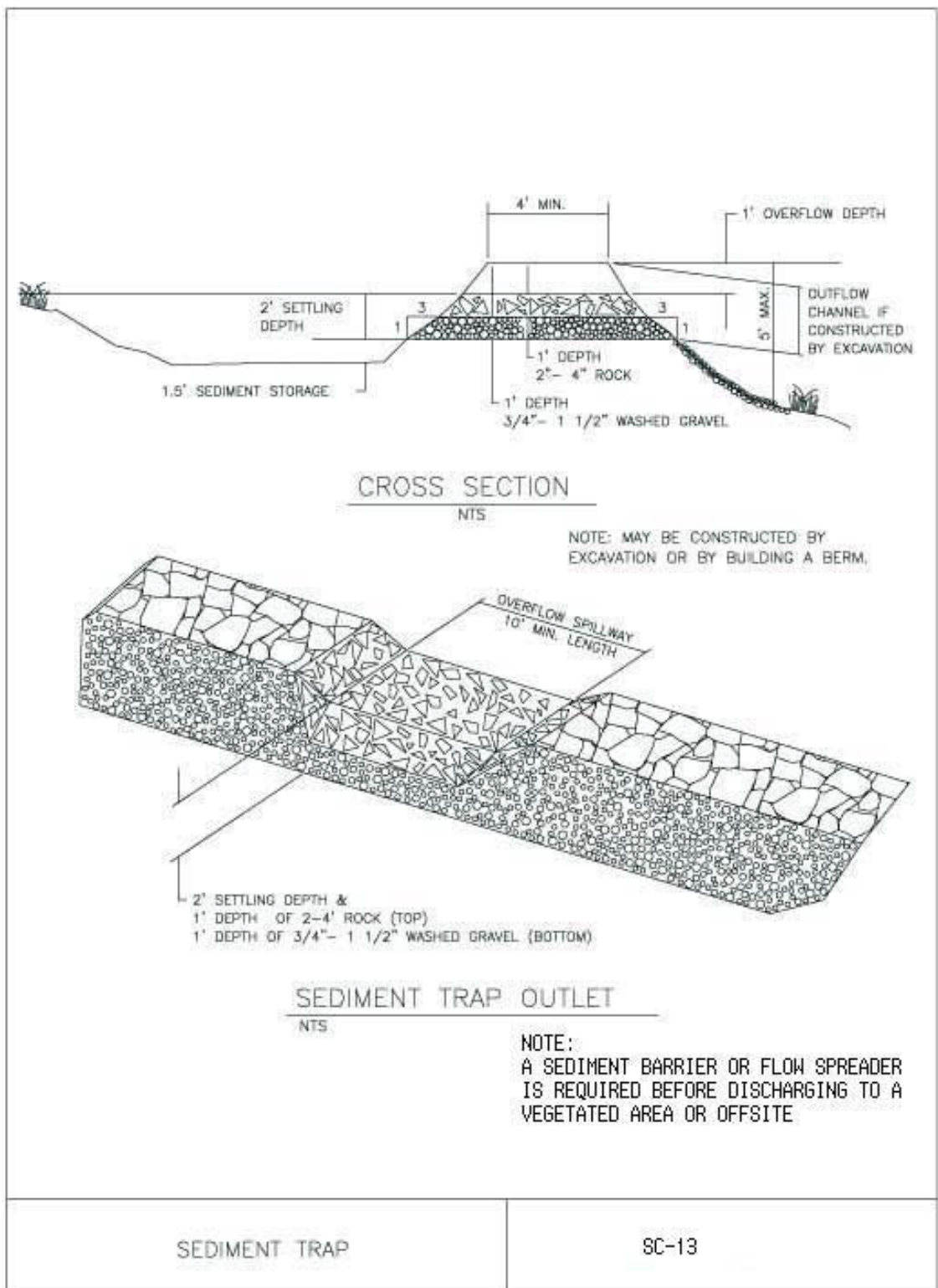
Monitoring/Maintenance: All sediment traps require continued maintenance to function properly. Excess sediment shall be removed to ensure basin capacity and trap efficiency.

- Inspect before, during, and after each rain event.
- All damage caused by soil erosion or construction equipment shall be repaired before the end of each working day.
- Remove sediment when the sediment storage zone is 1/3 full. This sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the embankment, or in or adjacent to a stream or floodplain.

- When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposit shall be leveled or otherwise disposed of in accordance with the approved Erosion Prevention and Sediment Control Plan.

Common Failures:

- Inadequate sizing.
- Lack of maintenance.



Chapter 6 Non-Stormwater Pollution Controls

6.1 Overview

This chapter defines and identifies the Plan requirements for non-stormwater pollution controls and summarizes individual control measures. The City of Gresham requires the Plan to include BMPs for non-stormwater discharges. These BMPs must be in-place at all times during construction.

6.2 Definition of Non-Stormwater Pollution Controls

Non-stormwater pollution controls consist of general site and materials management measures that directly or indirectly aid in minimizing the discharge of sediment and other construction related pollutants from the job site. Construction site work activities can generate a variety of pollutants, many of which are summarized in Table 6.2.1.

Required non-stormwater pollutant control measures:

- Areas used for storage of soils or wastes.
 - Stockpile protection.
 - Non-stormwater pollution control measures to prevent or minimize exposure to spills, cleaning and maintenance activities, and waste handling.
- Controls shall also be included for the following additional activities:
 - Proper material handling, use, and storage
 - Vehicle and equipment cleaning, fueling, and maintenance
 - Paving and concrete management
 - Contaminated soil management
 - Ponded water management
 - Any other activity with the potential to contribute to offsite pollutant discharges.

Special care and attention shall be given to chemicals and other potentially hazardous materials to ensure proper containment, spill control, and disposal.

TABLE 6.2.1. CONSTRUCTION WORK SITE ACTIVITIES AND ASSOCIATED POLLUTANTS

General Work Activity/Products with Potential Stormwater Pollutants	Specific Work Activity/Products with Potential Stormwater Pollutants	Associated Visible Pollutant Indicator	Associated Non-Visible Potential Pollutants
Adhesives	Adhesives, glues, resins, epoxy synthetics, PVC cement Caulks, sealers, putty, sealing agents Coal tars (naphtha, pitch)	Oily sheen or other discoloration from some products	Phenolics, formaldehydes, asbestos, benzene, phenols and naphthalene
Asphalt paving/Curbs	Hot and cold mix asphalt	Oil sheen	Oil, petroleum distillates
Cleaners	Polishes (metal, ceramic, tile) Etching agents Cleaners, ammonia, lye, caustic sodas, bleaching agents and chromate salts	Discoloration/plume from some products	Metals, acidity/alkalinity, chromium
Concrete/Masonry	Cement and brick dust Colored chalks Concrete curing compounds Glazing compounds Surfaces cleaners Saw cut slurries Tile cutting	Discoloration/plume from some products	Sediments, acidity, metals, asbestos, particulates
Drywall	Saw-cutting drywall	Discoloration/plume from drywall dust	Copper, aluminum, sediments, minerals, and asbestos
Framing/Carpentry	Sawdust, particle board dust, and treated woods Saw cut slurries	Sawdust, slurry plume	BOD, formaldehyde, copper and creosote
Grading/Earthwork	Blasting Dewatering Grading activities Vegetation removal Disturbance of contaminated soil	Sediment discharge/plume, non-stormwater discharges, vegetation debris	Soil amendments (gypsum, lime), historical soil contaminants
Heating, Ventilation, Air Conditioning	Demolition or construction of air condition and heating systems	None	Asbestos, Freon
Insulation	Demolition or construction involving insulation, venting systems	None	Asbestos, aluminum, zinc
Liquid waste	Wash waters Irrigation line testing/flushing	Non-stormwater discharges, detergents, sediment, oily sheen, concrete rinse, or other plume	See non-visible pollutants listed in other categories
Painting	Paint thinners, acetone, methyl ethyl ketone, stripper paints, lacquers, varnish, enamels, turpentine, gum spirit, solvents, dyes, stripping pigments and sanding	Paint plume	VOCs, metals, phenolics and mineral spirits
Planting/Vegetation management	Vegetation control (pesticides/herbicides) Planting Plant maintenance Vegetation removal	Mulch, sediment, vegetation	BOD, fertilizers, pesticides, herbicides, nutrients (nitrogen, phosphorous, and potassium) acidity/alkalinity, metals, aluminum sulfate, sulfur

TABLE 6.2.1. CONSTRUCTION WORK SITE ACTIVITIES AND ASSOCIATED POLLUTANTS

General Work Activity/Products with Potential Stormwater Pollutants	Specific Work Activity/Products with Potential Stormwater Pollutants	Associated Visible Pollutant Indicator	Associated Non-Visible Potential Pollutants
Plumbing	Solder (lead, tin), flux (zinc chloride), pipe fitting Galvanized metal in nails, fences, and electric wiring	None	Lead, copper, zinc and tin
Pools/fountains	Chlorinated water	Non-stormwater discharges	Chlorine or other disinfectant
Removal of existing structures	Demolition of asphalt, concrete, masonry, framing, roofing, metal structures	Sediment, other particulates	Toxics (paint strippers, solvents, adhesives), trace metals (galvanized metal, painted surfaces, preserved wood)
Roofing	Flashing Saw cut slurries (tile cutting) Shingle scrap and debris	Debris, slurry plume	Oil, petroleum distillates
Sanitary waste	Portable toilets Disturbance of existing sewer lines	Visible sanitary waste	Bacteria, BOD, pathogens
Soil preparation/ amendments	Use of soil additives/amendments	Mulch, sediment	Soil amendments
Solid waste	Litter, trash, and debris Vegetation	Plastic, paper, cigarettes, wood products, steel, vegetation waste, etc.	
Utility line testing and flushing	Hydrostatic test water Pipe flushing	Non-stormwater discharge, sediment	Chlorine
Vehicle and equipment use	Equipment operation Equipment maintenance Equipment washing Equipment fueling	Oil sheen, sediment	Total petroleum hydrocarbons, coolants, benzene and derivatives

DEWATERING AND PONDED WATER MANAGEMENT – NS-1

Application: Dewatering operations controls prevent or reduce the discharge of pollutants to the storm drain system or to watercourses from dewatering operations by using sediment controls and by testing the discharges for pollution. Dewatering and ponded water management applies to areas where storm water has collected in low spots, trenches or other depressions and needs to be removed to proceed with construction activities or for vector control. All dewatering discharge activities must be conducted in accordance with local agency (i.e., local sewerage agency or other applicable agency) permit requirements.

Construction Specifications/Installation:

- Ponded storm water shall be settled or filtered for sediment removal prior to discharge.
- Water from trench or excavation dewatering shall be tested if required by applicable permits and discharged in accordance with permit provisions.
- Water shall be clean and free of significant sediment, surfactants, or other pollutants.
- For clean ponded storm water, dewatering discharges (without state permit requirements), and authorized non-stormwater discharges, use one of the following methods for discharge disposal as appropriate for onsite drainage:
 - Reduce sediment discharge by pumping water from the top of ponded areas using a floating or raised hose.
 - Use water where possible for construction activities such as compaction and dust control and landscape irrigation. If used for these applications, ensure that the water will infiltrate and not run-off from the land to storm drain systems, to creek beds (even if dry) or to receiving waters.
 - Infiltrate to an appropriate stabilized surface area (landscaped or vegetated).
 - Discharge to an on-site temporary sediment pond.
 - Only with approval by the City of Gresham Stormwater Division Manager, discharge to the storm drain system. Water from dewatering must not contain significant sediments or other pollutants.
 - A vacuum truck may be used to remove the water and haul it to an authorized discharge location.
- If a state discharge permit is required, provide temporary onsite storage (e.g., Baker tank) of water removed from trenches and excavations until a permit to discharge is obtained.
- If a state discharge permit is obtained for discharge to a storm drain or sanitary sewer system, conduct all dewatering discharge activities in accordance with permit requirements.

Monitoring/Maintenance:

- Inspect pumps, hoses and all equipment before use. Monitor dewatering operations to ensure it does not cause offsite discharge or erosion.
- Inspect routinely, when applicable activities are under way.

PAVING OPERATIONS CONTROLS – NS-2

Application: Paving and grinding operation controls to minimize pollution of storm water runoff during paving operations.

Design Guidelines: The purpose is to prevent and reduce the discharge of pollutants by properly disposing of wastes and by implementing measures to control run-on and prevent runoff from picking up pollutants and carrying them into the storm drain system or to watercourses.

Construction Specifications/Installation:

- In order to reduce the potential for the transport of pollutants in storm water runoff from paving operations, paving shall not take place within 72 hours of a predicted significant (>0.10 inch) storm event. If paving does occur within 72 hours of a significant storm event, catch basin filters or other appropriate BMPs shall be utilized to trap hydrocarbons.
- Protect storm drain inlets near work and down gradient of work areas during saw cutting, paving, or grinding operations.
- Saw-cut slurry shall not discharge to any portion the public or private stormwater system and shall be shoveled or vacuumed and removed from site.
- Paving materials and machinery shall be stored away from storm drains and water bodies and secondary containment will be used to catch drips, leaks or spills where applicable.
- If onsite mixing is planned then an area shall be designed for conducting the mixing. This area shall be paved or made impervious (e.g., plastic or wood sheeting) and be located away from storm drain inlets or watercourses.
- Minimize overspray of tackifying emulsions or placement of other paving materials beyond the limits of the area to be paved.
- Use dry methods to clean equipment and conduct cleaning in accordance with Vehicle and Equipment Cleaning (NS-5).
- Material use and stockpiles shall be managed in accordance with BMPs EP-22 (Soil Stockpile Management), NS-8 (Material Use) and NS-9 (Stockpile Management).
- Collect and remove all broken asphalt and concrete or excess materials, recycle when feasible and dispose of materials in accordance with City, state, and federal requirements.
- Do not apply asphalt, concrete paving, seal coat, tack coat, slurry seal or fog seal if rain is expected during the application or curing period.
- Avoid transferring, loading, or unloading paving materials near storm drain inlets or watercourses. If not possible, use Storm Drain Inlet Protection (SC-8).

Monitoring/Maintenance:

- Inspect and maintain equipment and machinery routinely to minimize leaks and drips.
- Inspect inlet protection measures routinely.

TEMPORARY EQUIPMENT BRIDGE – NS-3

Application: Temporary equipment bridges are temporary structures placed across a waterway that allow vehicles to cross the waterway during construction without entering the water to prevent erosion caused by vehicles. This BMP details two types of temporary stream crossings:

1. Bridges – Appropriate for streams with high flow velocities, steep gradients and/or where temporary restrictions in channel are not allowed.
2. Culverts – Used on perennial and intermittent streams.

Design Guidelines: Temporary equipment bridges must be designed and installed properly to avoid flow restrictions, backups, washouts, and scour that could result in increased pollutant loads. Note: temporary equipment bridges may require permits from the U.S. Army Corps of Engineers (USACE) and/or the Oregon Department of State Lands (DSL), depending on the project scope and location. If a permit is not required, the City requires a written confirmation from the USACE and DSL that a permit is not required.

Materials/Equipment: Varies.

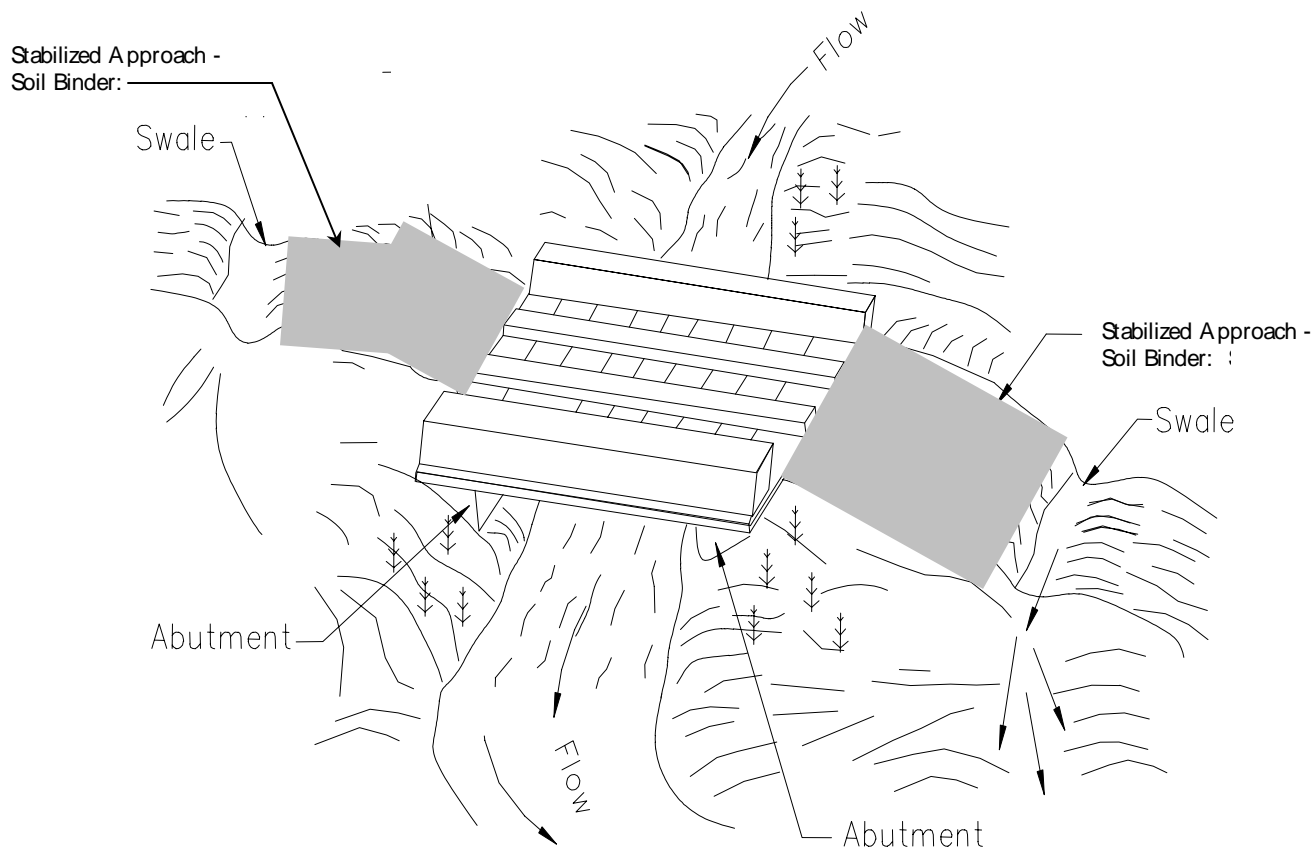
Construction Specifications/Installation:

- Location of the temporary stream crossing shall address:
 - Site selection where erosion potential is low.
 - Areas where the side slopes from pipeline right-of-way will not spill into the side slopes of the crossing.
- Design and installation requires knowledge of stream flows and soil strength. Designs shall be prepared under direction of and approved by a registered civil engineer. Both hydraulic and construction loading requirements shall be considered with the following:
 - Provide stability in the crossing and adjacent areas to withstand the design flow. The design and safety factor shall be selected based on careful evaluation of the risks due to over topping, flow backups, or washout.
 - Avoid oil or other potentially hazardous waste materials for surface treatment.
 - Provide temporary stabilization to minimize potential sedimentation from disturbed area around crossing.
- Construction consideration shall include:
 - Stabilize construction right-of-way, adjacent work area and stream bottom against erosion.
 - Schedule construction during dry periods to minimize stream disturbance.
- Specific consideration for the two types of stream crossings include:
 - Bridges: Generally more expensive to design and construct, but provide the least disturbance of the streambed and least constriction of the waterway flows.
 - Culverts: Relatively easy to construct and able to support heavy equipment loads.
- Installation may require dewatering or temporary diversion of the stream. See BMPs NS-1, Dewatering, and RC-9, In-Stream Diversion.

Monitoring/Maintenance:

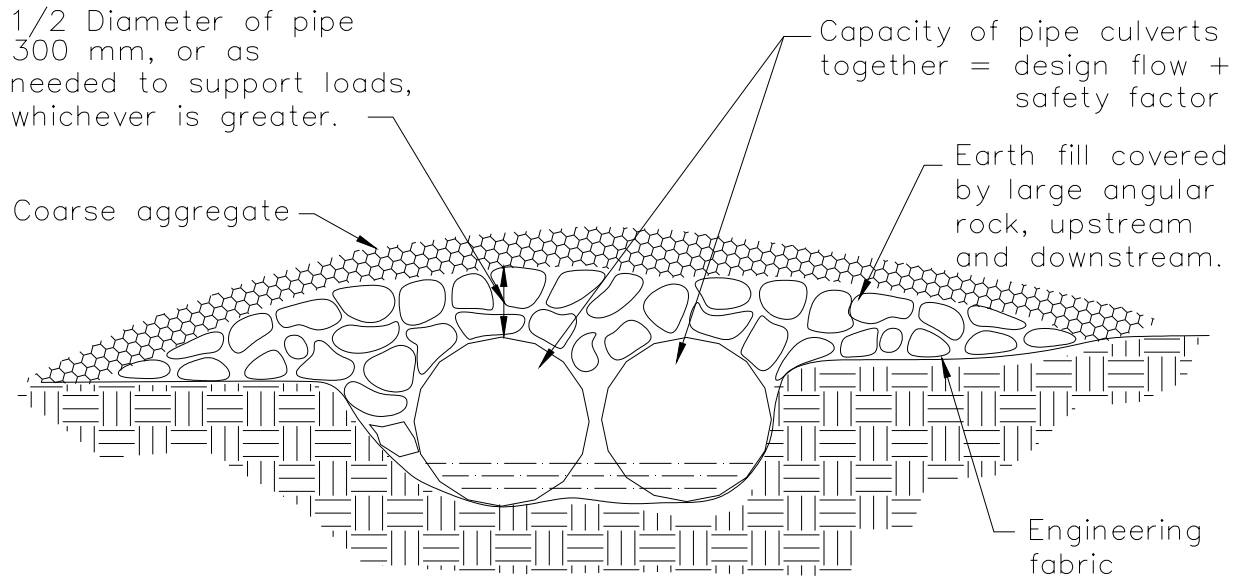
- Monitoring, at a minimum, shall occur weekly and after each significant rainfall, including:
 - Check for blockage in the channel, sediment buildup in culverts or behind ford, or trapped debris.
 - Check for erosion of abutments, channel scour, riprap displacement, or piping in the soil.
 - Check for structural weakening of the temporary crossing, such as cracks, rills, and undermining of foundations and abutments.

- Maintenance provisions shall include:
 - Periodic removal from culverts and under bridges.
 - Replacement of lost aggregate from inlets and outlets of culverts.
 - Prompt removal of temporary crossing when it is no longer needed.
 - Provide temporary or permanent stabilization of disturbed area after crossing is removed.

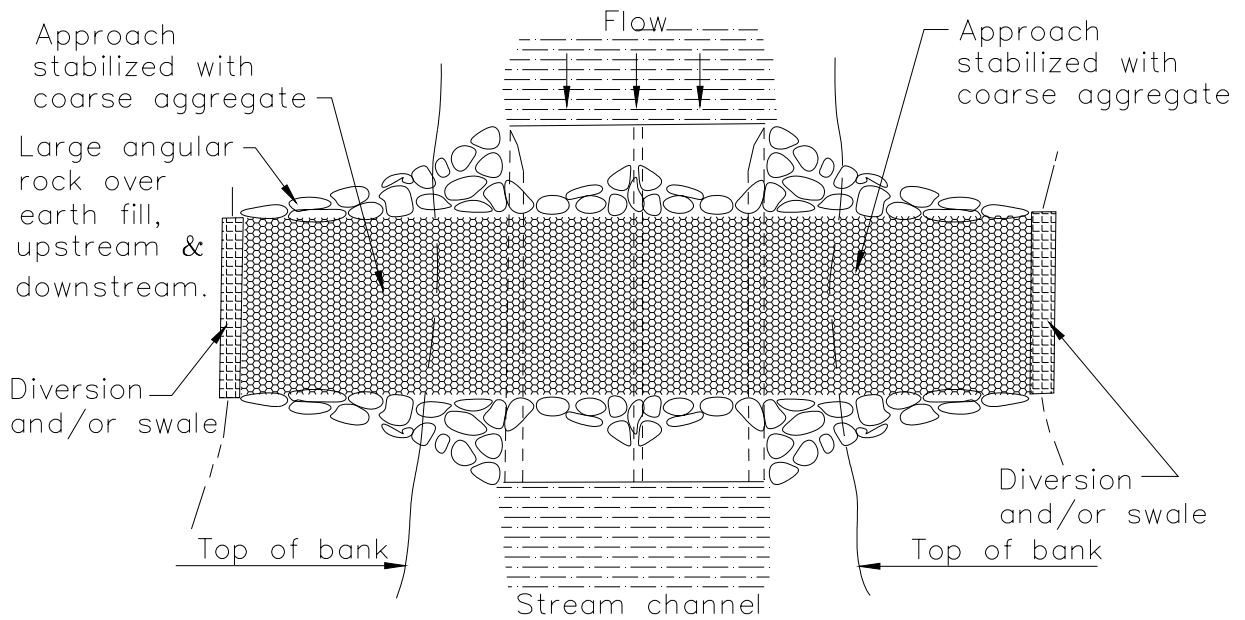


NOTE:
Surface flow of road diverted
by swale and/or dike.

TYPICAL BRIDGE CROSSING NOT TO SCALE



ELEVATION



PLAN VIEW

TYPICAL CULVERT CROSSING NOT TO SCALE

ILLICIT CONNECTION / ILLEGAL DISCHARGE – NS-4

Application: Illicit connections to the storm drain system and wastes discharged illegally are prohibited and can cause water quality impacts to receiving streams. This BMP identifies inspection and reporting procedures for contractors to identify illicit connections and illegal discharges at their job site.

Design Guidelines: The procedures and practices below are designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

Monitoring/Maintenance:

Planning

- Inspect site before beginning the job for evidence of illicit connections or illegal dumping or discharges.
- Inspect site regularly during project execution for evidence of illicit connections or illegal dumping or discharges.
- Observe site perimeter for evidence or potential of illicitly discharged or illegally dumped material, which may enter the job site.
- Identified illicit connections and illegal dumpings or discharges shall be reported to the Project Superintendent and City Inspector.

Solids. Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.

Liquids. Signs of illegal liquid dumping or discharge can include:

- Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils.
- Pungent odors coming from the drainage systems.
- Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes.
- Abnormal water flow during the dry weather season.

Urban Areas. Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:

- Abnormal water flow during the dry weather season.
- Unusual flows in sub-drain systems used for dewatering.
- Pungent odors coming from the drainage systems.
- Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes.
- Excessive sediment deposits, particularly adjacent to or near active off-site construction projects.

Rural Areas. Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:

- Abnormal water flow during the dry weather season.
- Non-standard junction structures.
- Broken concrete or other disturbances at or near junction structures.

Reporting

- Notify the Project Superintendent and City Inspector of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

VEHICLE AND EQUIPMENT CLEANING – NS-5

Application: Vehicle and equipment cleaning controls are procedures and practices to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning to the storm drain system or to watercourses.

Construction Specifications/Installation:

- Only vehicle wheel washing is allowed on construction sites to prevent offsite sediment tracking.
- Concrete truck and equipment washing shall follow the specifications outlined in BMP NS-14.
- Vehicles and equipment shall be washed off site at a controlled wash facility.
- Only in emergency situations is onsite vehicle washing allowed. Use “dry cleaning methods” such as wiping down vehicles rather than water washing vehicles on site. If cleaning must be conducted on site, it shall be conducted in a dedicated area with the following characteristics:
 - Located away from storm drain inlets, drainage facilities, or watercourses. At no time is wash water allowed to discharge into any portion of a public or private stormwater system.
 - Paved with concrete or asphalt, or stabilized with an aggregate base.
 - Bermed to contain wash water and to prevent run-on and runoff.
 - Configure wash area with a sump to allow collection and disposal of wash water by vacuum truck.
 - Discharges of wash water to a sanitary or process waste sewer must be approved by the City Wastewater Services Division.
- When cleaning vehicles or equipment with water:
 - Use as little water as possible. High pressure sprayers may use less water than a hose, and shall be considered.
 - Use positive shutoff valve to minimize water usage.
 - Do not use solvents or detergents to clean vehicles or equipment on site.
 - Do not permit steam cleaning on site.

Monitoring/Maintenance:

- Inspect and clean work areas regularly to limit wind blow debris and pollutants transported by storm water.

VEHICLE AND EQUIPMENT FUELING, MAINTENANCE, AND STORAGE – NS-6

Application: Vehicle and equipment fueling, maintenance, and storage controls are procedures and practices to minimize or eliminate the discharge of fuel and lubricant spills and leaks to the storm drain system or to watercourses.

Design Guidelines: Vehicles and heavy machinery are a potential source of pollutants such as petroleum products, antifreeze, and exhaust and waste oil containing heavy metals. Pollutants may enter stormwater runoff by means of direct contact with machine ports and by contact with spills on surfaces and the ground. Use specifications to help prevent contact of these potential pollutants with stormwater and ground surfaces.

Construction Specifications/Installation:

Fueling. On site vehicle and equipment fueling shall only be used where it is impractical to send vehicles and equipment offsite for fueling. When fueling must occur on site, the contractor shall select and designate an area to be used, subject to approval. Vehicle and equipment fueling (including fueling of handheld equipment) shall be conducted in accordance with the following:

- Away from storm drain inlets, drainage facilities, or watercourses.
- On a paved surface where practical, and within a berm to prevent run-on, runoff, and to contain spills.
- Store portable fuel containers for hand-held equipment in a tub or equivalent device to avoid spills/leaks.
- Use secondary containment techniques for fueling of handheld or portable equipment, such as drain pans or drop cloths to catch spills or leaks.
- All fueling shall be conducted with the fueling operator in attendance at all times.
- Use vapor recovery nozzles to help control drips and reduce air pollution and nozzles equipped with automatic shutoff features to prevent overtopping fuel tank.
- Signage that fuel tanks shall not be “topped off.”
- An adequate supply of spill clean up materials shall be readily accessible to all fueling activities.

Maintenance. Maintenance of large equipment shall be conducted within designated maintenance yards in order to enable careful management. During minor routine maintenance, drip pans shall be placed under vehicles and equipment. All on site vehicles shall be monitored for leaks and shall receive preventive maintenance to reduce leakage.

Only necessary maintenance required for the proper functioning of handheld equipment and portable generators/compressors is allowed onsite. Drop clothes, trays or an equivalent method shall be used underneath handheld and portable equipment to avoid leaking fluids, fuels, oils, or grease onto the ground. Do not overspray aerosols to the ground or other rain-exposed surfaces. Clean up spills immediately and dispose of waste properly.

Fuel and Vehicle Storage. Fuel storage shall be conducted in accordance with applicable local, state, and federal regulations and in accordance with BMP NS-12, Hazardous Materials and Waste Management. Vehicles and equipment shall be stored in designated, bermed vehicle storage areas (such as dedicated storage areas or fueling and maintenance areas) when possible, or off of paved areas to the

extent practical. During long periods (typically more than one month) of storage, and when otherwise necessary drip pans shall be placed under vehicles and equipment that are prone to leakage. Plastic tarps shall be placed over exposed equipment when not in use for long periods (>3 months) to prevent contact with stormwater. All on site vehicles shall be monitored for leaks and shall receive preventive maintenance to reduce leakage.

Monitoring/Maintenance:

- Check to ensure adequate supply of spill cleanup materials is available.
- Perform routine inspections of designated maintenance, cleaning, and fueling areas.
- Report all spills immediately to the project Superintendent. A spill of any size that discharges directly to a stream or any spill over 42 gallons to the ground, must be reported to DEQ immediately.
- Service sumps regularly.

MATERIAL DELIVERY AND STORAGE CONTROLS – NS-7

Application: Material delivery and storage controls are procedures and practices for the delivery and storage of materials in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Design Guidelines: Many materials used in construction can contribute pollutants to storm water runoff. Examples of such materials include soil, vehicle fuels, oils, antifreeze, paints/coatings, pressure treated lumber, dry wall, fertilizers, pesticides, and herbicides.

Construction Specifications/Installation:

- All construction materials shall be delivered to and stored in designated areas or designated staging areas at the construction site.
- Material storage areas shall be placed near construction site entrances to the extent practicable, away from storm drain inlets, culverts and surface waterbodies.
- Designated storage areas shall be kept clean, well organized, and litter-free.
- Any materials being stored that could release pollutants by wind or runoff transport shall be protected by overhead cover, secondary containment, tarpaulins, visqueen/plastic sheeting or other appropriate method prior to rainfall or periods of high wind. Where feasible, store materials indoors (e.g., container storage or garages/buildings under construction, where work is being conducted).
- Any chemicals, drums or bagged materials not stored in a covered location, shall be stored on pallets and in secondary containment.
- Secondary containment shall be provided for liquids.
- Secondary containment areas shall be covered to prevent accumulation of rainwater.
- Construction materials shall be stored in a manner to prevent or minimize contact with storm water.
- The main loading, unloading, and access areas shall be located away from storm drain inlets and channels.
- Enclosures or flow barriers (berms) shall be constructed around designated storage areas to prevent storm water flows from entering storm drains or receiving waters and to control the discharge of sediments and other pollutants.
- Deliveries shall be scheduled in a manner that reduces the time for onsite storage of potentially polluting materials prior to use and minimize the number of material drop locations.
- Fuels shall be stored in accordance with BMP NS-6, Vehicle and Equipment Fueling, Maintenance, and Storage.
- Hazardous materials shall be stored in accordance with BMP NS-12, Hazardous Material and Waste Management.

Monitoring/Maintenance:

Inspect material storage areas routinely for compliance with the above practices.

MATERIAL USE – NS-8

Application: Material use controls are procedures and practices for use of construction materials in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Design Guidelines: Apply this BMP when the following materials are used or prepared on site: pesticides and herbicides; fertilizers and soil amendments; detergents; petroleum products such as fuel, oil, and grease; asphalt and other concrete components; plaster; hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds; mastic, pipe wrap, primers, and paint; concrete compounds; welding material; and other materials that may be detrimental if released to the environment.

Construction Specifications/Installation:

- Order and store only materials that are required for site needs.
- Materials shall be delivered at such time to minimize onsite storage.
- Materials shall be used in accordance with manufacturer directions and in a manner to reduce or eliminate release of pollutants
- An accurate, up-to-date inventory of materials delivered and stored on-site shall be kept by each contractor.
- Reduce or eliminate use of hazardous materials on site when practical. Use safer, recycled and/or less hazardous products when practical.
- Use materials only where and when needed to complete the construction activity.
- Recycle residual paints, solvents, non-treated lumber, and other materials.
- Do not remove the original product label; it contains important safety and disposal information.
- Use the entire product before disposing of the container.
- Keep an ample supply of spill clean up material near use areas. Instruct employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall unless sufficient time has been allowed for them to dry or cure.

Monitoring/Maintenance:

- Spot check employees and subcontractors monthly throughout the job to ensure appropriate practices are being employed.

NON-SOIL STOCKPILE MANAGEMENT – NS-9

Application: Non-soil stockpile management practices are designed to reduce or eliminate air and storm water pollution from stockpiles of sand, and paving materials, such as Portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub-base or pre-mixed aggregate, asphalt binder (so called “cold mix” asphalt), and pressure treated wood.

For soil stockpile management see EP-22, and for topsoil stockpile management, see EP-4.

Construction Specifications/Installation:

All Stockpiles

- Locate stockpiles a minimum of 50 feet away from inlets, drainage courses, or water bodies.
- Keep stockpiles organized and surrounding areas clean.
- Protect storm drain inlets, drainage courses, and receiving waters from non-soil stockpiles, using drain inlet protection and perimeter sediment controls as appropriate.
- Implement dust control practices as appropriate to prevent wind erosion of stockpiled material.
- Temporary non-soil stockpiles not removed or used by the end of one workday must be managed in accordance with this BMP and in all cases protected prior to rainfall.

Stockpiles of Portland Cement, Sand, Mulch, Concrete Rubble, Asphalt Concrete, Asphalt Concrete Rubble, Aggregate Base, or Aggregate Sub-Base

- Protect non-soil stockpiles with a perimeter sediment control, such as a berm, sediment fence, fiber rolls, or sand/gravel bags year round.
- Non-soil stockpiles shall additionally be covered or stabilized between October 1 and May 31, and as necessary during significant forecasted storm events (> 0.25 inch), prolonged periods of rain, and to protect from wind erosion.

Stockpiles of “Cold Mix” or Other Pollutants Easily Transported in Storm Water (Cement, Lime, and Other Caustic Amendments)

- Stockpiles shall be placed on plastic or comparable material at all times.
- Stockpiles shall be covered between October 1 and May 31 with 6-millimeter plastic or comparable material and prior to the onset of significant rain (> 0.1 inch).

Bagged Materials

- Bagged materials shall be placed on pallets at all times and under cover (e.g., plastic sheeting, indoors) between October 1 and May 31, and prior to the onset of significant rain (>0.10 inch).

Stockpiles/Storage of Pressure Treated Wood with Copper, Chromium, and Arsenic or Ammoniacal Copper, Zinc, and Arsenate

- Stockpiles of treated wood shall be covered with plastic or comparable material between October 1 and May 31, and prior to the onset of significant rain (>0.25 inch).

Monitoring/Maintenance:

- Inspect non-soil stockpiles regularly and repair and/or replace covers, and perimeter controls, as needed.

SPILL PREVENTION AND CONTROL PROCEDURES – NS-10

Application: Spill prevention and control measures are procedures and practices to prevent and control spills in a manner that minimizes or eliminates the discharge of spilled material to the storm drain system or to watercourses.

Design Guidelines: Spills and leaks can be significant sources of stormwater pollutants and are, in most cases, avoidable.

Construction Specifications/Installation:

- The contractor shall prepare a site/project specific spill response plan that identifies the type and location of products or wastes on the site with spill potential, the location of spill cleanup materials, storm drains or sensitive areas that require immediate response, personnel responsible for spill response and notifications, and spill cleanup procedures.
- Heavy equipment (e.g., bulldozers and other grading equipment) and vehicles shall be inspected daily for leaks and shall be repaired as necessary. Use secondary containment and drip pans for vehicle fueling, maintenance, and storage (see BMP NS-6, Vehicle and Equipment Fueling, Maintenance, and Storage).
- Despite precautions, spills may still occur at the site. Spills (liquid or dry materials) shall not be cleaned up by hosing off the area. In the event that a spill does occur, the spill shall be controlled as follows:
 - Any fuel products, lubricating fluids, grease or other products and/or waste released from vehicles, equipment, or operations shall be collected and disposed of in accordance with City, state, and federal regulations;
 - If a spill occurs during a rain event, the area shall be contained and covered immediately. If the spill is a liquid, absorbent material also shall be used. The spill shall be cleaned up at the cessation of rain; and
 - Spill cleanup materials shall be stored near potential spill areas (e.g., painting, vehicle maintenance areas).

Reportable Spill Quantities. Any spill (hazardous or non-hazardous) over 42 gallons or any spill directly discharging to a stream or waterway must be reported. The project Superintendent will notify the Oregon Emergency Response System (OERS), Oregon DEQ, and the City Inspector. It is the project Superintendent's responsibility to have all of the emergency phone numbers at the construction site.

For spills of federal Reportable Quantity (as established under 40 CFR Parts 110, 117, or 302), the project Superintendent will notify the National Response Center by telephone at (800) 424-8802 within 24 hours. Within 14 days, the project Superintendent will submit a written description of the release to EPA Region 10, including the date and circumstances of the incident and steps taken to prevent another release.

Minor Spills. Minor spills typically involve small quantities of oil, gasoline, paint, etc. that can be controlled by the first responder at the discovery of the spill. Control of minor shall include:

- Containing the spill immediately.
- Recovering spilled materials (if possible).
- Cleaning the contaminated area and dispose of contaminated materials.

Medium-Sized Spills. Medium-sized spills still can be controlled by the first responder, along with the aid of other personnel such as laborers, foremen, etc. This response may require the cessation of other activities. Spills shall be cleaned up immediately, as follows:

- Notify the project foreman immediately. The foreman/superintendent is responsible for any necessary notifications (fire department, etc.).
- Contain the spread of the spill (using sand bags or other barriers) immediately.
- If the spill has occurred on a paved or impermeable surface, clean it up using dry methods (absorbent materials, cat litter, and/or rags). Contain the spill by encircling it with absorbent materials.
- If the spill has occurred on an unpaved or permeable surface, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
- If the spill has occurred during a rain event, cover and contain the spill area. Absorbent material also shall be placed if the spill is liquid.
- **Significant/Hazardous Spills.** For large spills or spills involving hazardous materials that cannot be controlled by project personnel, the following steps shall be taken:
- The Foreman shall notify the project Superintendent immediately and follow up with a written incident report.
- The project Superintendent will immediately notify local emergency response personnel by dialing 911
- Retain the services of a Spill Cleanup Contractor or HazMat Team immediately. Construction personnel shall not attempt to clean up the spill until the appropriate and qualified staff has arrived at the site.
- Other agencies that may need to be contacted include the Gresham Fire Department, Oregon Department of Transportation, etc.

Monitoring/Maintenance:

- Inspect work and material storage areas routinely for adequate containment to avoid uncontrolled releases.

SOLID WASTE MANAGEMENT – NS-11

Application: Solid waste management controls are procedures and practices to minimize or eliminate the discharge of pollutants to the storm drain system or to watercourses as a result of the creation, stockpiling, and removal of construction site wastes.

Construction Specifications/Installation:

- Solid wastes shall be cleaned up daily. Paved areas shall be swept, not washed. Use of water for cleaning is prohibited unless approved on a project specific basis by the owner. If approved, wash water shall not be discharged to the storm sewer and shall be collected, contained and disposed of appropriately (see bullet below regarding liquid wastes).
- There shall be designated temporary waste storage areas on the site.
- Designated waste storage areas shall be contained within earthen berms or provided with other perimeter protection to prevent run-on to and runoff from the area.
- Non-hazardous construction wastes (e.g., vegetation, trash, and construction debris) shall be collected daily and before storm events and deposited at the designated waste storage areas.
- When practical, wastes shall be stored within covered, water-tight dumpsters and/or containers that prevent exposure to rain and prevent loss of wastes when it is windy.
- Dumpsters shall not be hosed out on the construction site. Any required dumpster cleaning will be done off-site by the trash hauling contractor.
- Any waste containers constructed on-site (not prefabricated) shall be inspected prior to use and inspected regularly to verify integrity.
- Any wastes stored in open containers or waste piles shall be covered prior to significant forecasted rain (0.25 inch).
- All waste materials shall be removed from the storage areas on a weekly basis, or more frequently if capacity is reached, and disposed or recycled in accordance with all City, state, and federal regulations.
- Any solid waste that accumulates at erosion and sediment control devices shall be removed daily.
- Liquid wastes shall be managed in accordance with the BMP NS-16, Liquid Waste Management.

HAZARDOUS MATERIALS AND WASTE MANAGEMENT – NS-12

Application: Hazardous materials and waste management controls are procedures and practices to minimize or eliminate the discharge of pollutants from construction site hazardous waste to the storm drain system or to watercourses.

Construction Specifications/Installation:

Hazardous Materials

- Storage of hazardous materials on site shall be minimized. Any hazardous materials used during construction shall be containerized and kept closed during work activities.
- Hazardous material storage shall conform to all applicable local, state and federal requirements.
- Hazardous materials shall be stored in sealed containers within an enclosed container or a bermed and permanently covered storage area. Lids alone shall not be considered adequate cover.
- Dedicated areas of the construction site shall be designated for hazardous material delivery and storage. Designated storage areas will be placed away from drain inlets, culverts, and surface waterbodies, preferably near construction site entrances.
- Designated storage areas shall be kept clean and well organized.
- The following types of materials shall be stored in accordance with these provisions: fertilizers, herbicides, pesticides, detergents, oil, grease, glues, paints, solvents, curing compounds materials, and other similar materials that could be considered potential pollutants in storm water discharge.
- Fuel shall be stored and managed in accordance with BMP NS-6, Vehicle and Equipment Fueling, Maintenance, and Storage.
- Regular inspections of storage areas shall be conducted to monitor inventory and check for leaking containers.

Hazardous Wastes

- Hazardous wastes and containers shall be placed in a designated hazardous waste storage area that is permanently covered and has an impermeable bottom surface surrounded by secondary containment to minimize the mixing of wastes with storm water and to prevent the direct release of liquid waste to storm water. Temporary storage and removal of hazardous wastes from the site shall be in accordance with all applicable state and federal laws.
- Wastes shall be segregated and recycled where feasible (e.g., paints, solvents, used oil, batteries, anti-freeze). Wastes shall not be mixed since this can cause potentially dangerous chemical reactions, make recycling impossible and complicate disposal.
- Covered waste bins shall be designated for the disposal of all empty hazardous waste product (e.g., paints, solvents, glues, petroleum products, exterior finishes, pesticides, fertilizers, etc.) containers. The original product label shall not be removed as it contains important safety and disposal information.

- Toxic wastes and chemicals shall not be disposed of in dumpsters designated for construction debris.
- If any asbestos is discovered in the demolished materials, asbestos removal and disposal shall be performed by a licensed contractor or licensed subcontractor trained in asbestos removal. All removal and disposal shall be done in accordance with state and federal regulations. Any asbestos wastes stored on-site prior to removal shall be stored within dumpsters (roll-offs) covered with tarps or other appropriate method to prevent contact with rain and minimize exposure to wind.
- Employees and subcontractors shall be trained on proper storage practices.

CONTAMINATED SOIL MANAGEMENT – NS-13

Application: Contaminated soil management controls are procedures and practices to minimize or eliminate the discharge of pollutants to the storm drain system or to watercourses as a result of construction activity in or near contaminated soils.

Design Guidelines: A number of practices occurring during construction may lead to contamination of soils. For example, leaks and spills of petroleum products from leaking vehicles and routine vehicle and equipment maintenance can cause soil contamination.

Construction Specifications/Installation:

- All soils contaminated by construction activities must be removed and disposed of per state disposal requirements.
- In the event that soil contamination is suspected but not confirmed, the contractor will obtain samples for analysis by a certified analytical laboratory.
- Decisions regarding soil removal and disposal will be based on the results of the analysis.
- No soils contaminated by construction activities shall be buried or otherwise disposed of on site.
- Areas of historic contamination shall be managed in accordance with approved remediation work plans or equivalent documents.
- Containment shall be provided around areas of historic contamination or soils contaminated by construction activities (not yet removed) to eliminate run-on to and off-site discharges from these areas and associated non-visible pollutant monitoring requirements. Containment zones shall consist of earthen berms, excavated diversion channels, or over excavation in the area of concern to create a “bath-tub.”
- Contaminated soils may be temporarily stored in accordance with applicable City, state, and federal regulations. At a minimum soils shall be stored on a contained, impervious surface and be covered prior to proper disposal.

CONCRETE MANAGEMENT – NS-14

Application: Concrete management controls are procedures and practices to minimize or eliminate the discharge of concrete residuals and waste to the storm drain system or to watercourses.

Design Guidelines: Concrete trucks and equipment will be washed-out on site utilizing a concrete washout to collect all wash water and concrete waste. The washout area will be located away from storm drains, open ditches or water bodies. Signs will be posted throughout the jobsite, directing crews and concrete trucks to concrete washouts. Upon completion of the concrete work, the contractor shall break up, remove, and haul away or reuse on site solid concrete that has accumulated in the washout.

Construction Specifications/Installation:

Material Use

- A washout shall be an excavated depression with dimensions large enough to prevent concrete slurry overflow. All concrete washing activities shall be done so that slurry is collected in the washout.
- Install storm drain protection at any down-gradient inlets that may be impacted by the activity. See BMP SC-8, Storm Drain Inlet Protection.
- Do not place concrete during rain (precipitation that is sufficient to cause local runoff) or within 18 hours of forecasted rain.
- Place stoppers on concrete truck chutes during travel onsite to manage potential dribbling of concrete material.
- Minimize amount of curing compound and form oil used and do not overspray onto a non-target surface.
- When sandblasting, use shrouds where necessary to contain waste from sandblasting. Conduct work in accordance with applicable air quality standards. Collected debris for proper disposal as soon as possible, and prior to rain events.
- Minimize the amount of water used during coring/drilling or saw cutting. During wet coring or saw cutting, use a shovel or wet vacuum to lift the cooling water/slurry from the pavement. Additionally, if wet vacuuming is not adequate to capture wastewater from the activity, sand bag barriers or other containment shall be used.
- If concrete residue remains after drying, the area shall be swept up and residue removed to avoid contact with storm water or entering a storm drain or water body via the wind.
- The sweepings shall be collected and returned to the aggregate stockpile or disposed in the trash and not washed into the street or storm drain.
- Washing of fresh concrete shall be avoided, unless runoff can be drained to a bermed or level area, away from storm drain inlets and channels.
- Acid washing of concrete shall be minimized. Where required, acid wash shall be directed into a collection area lined with visqueen. Residuals shall be collected and properly disposed of as hazardous waste.

- Handling of wet concrete, such as moving a pumper chute or transporting material in a wheelbarrow from the delivery truck, must be performed in a controlled manner to prevent drips and spills outside the target pour area. Minimize water use.
- Concrete drips, spills, over pours, and equipment rinse water landing on rain-exposed outside of any BMP device must be collected and have the surface cleaned and waste disposed of properly prior to the end of the workday or before the next rain event. Concrete-laden equipment implements (e.g., crane buckets) must be stored on top of heavy mil plastic until dry. Used forms that are not immediately placed into a haul truck when removed from foundations must also be temporarily staged over plastic sheeting or an equivalent until rinsed, wiped, or dried or until hauled off-site.

Waste Management

- Do not discharge concrete residue or particulate matter into a storm drain inlet or watercourse.
- Excess concrete shall not be dumped on-site.
- The following options shall be used for concrete truck chute and/or pump and hose washout:
 - **Concrete Washouts:** Washout stations can be a plastic lined temporary pit or bermed area designed with sufficient volume to completely contain all liquid and waste concrete materials plus enough capacity for rainwater. The designated area shall be located away from storm drain inlets, or watercourses. New washouts shall be constructed as needed to provide sufficient washout capacity on-site. Wastes other than concrete (i.e., trash, paint wastes etc.) shall not be disposed of in the washout.
 - **Washout in Trench:** Manually rinse the concrete truck chute into the trench itself.
 - **Bucket Washout:** Manually rinse the chute into a wheelbarrow, plastic bucket or pail, and then empty the bucket into the concrete truck barrel or on top of the placed concrete.

Monitoring/Maintenance:

- Responsible personnel shall ensure that all concrete truck drivers are instructed about project practices when the trucks arrive on site.
- Clean out designated washout areas as needed or at a minimum when the washout is 75% full to maintain sufficient capacity throughout the project duration.
- Any designated onsite washout areas shall be cleaned out and all debris removed upon project completion. Dispose of concrete waste according to BMP NS-11, Solid Waste Management.
- Inspect routinely, when applicable activities are underway to ensure that concrete washout does not overflow and that freeboard is adequate to contain concrete and rain.

SANITARY WASTE MANAGEMENT – NS-15

Application: Sanitary and septic waste management controls are procedures and practices to minimize or eliminate the discharge of construction site sanitary/septic waste materials to the storm drain system or to watercourses.

Construction Specifications/Installation:

- All sanitary wastes shall be collected and managed through the use of portable toilet facilities.
- Portable toilets shall be placed on a level surface and to the extent practical, a safe distance away from paved areas and away from storm drains.
- Portable toilets shall be provided with secondary containment.
- If placed in an area of high winds, portable toilets shall be secured to the ground to prevent blowing over.
- Portable toilets shall be transported to and from the construction site by a licensed contractor.
- No sanitary wastes shall be disposed of on site (e.g., to on-site storm drains, burial).
- Care shall be taken during pump-out to avoid spillage. If spillage occurs, it shall be cleaned up immediately.

LIQUID WASTE MANAGEMENT – NS-16

Application: Liquid waste management is applicable to construction projects that generate non-hazardous by products, residuals, or wastes, including but not limited to drilling slurries and fluids, grease-free and oil-free wastewater and rinse water, dredging spoils, or other non-stormwater liquid discharges not permitted by separate permits.

Design Guidelines: Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by products, residuals, or wastes, as noted above.

Separate BMPs shall also be referenced for the following on-site liquid wastes:

- NS-1, dewatering operations.
- NS-12, liquid hazardous wastes.
- NS-14, concrete slurry residue.

Construction Specifications/Installation:

- Vehicle and equipment cleaning using water is discouraged on site. Refer to BMP NS-5.
- Drilling residue and drilling fluids shall be disposed of in accordance with appropriate requirements at an approved disposal site.
- Wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, shall be contained and not allowed to flow into storm drain system, drainage channels, or receiving waters.
- Contain non-hazardous liquid wastes in a controlled area, such as a lined holding pit, lined sediment basin, roll-off bin, or portable tank.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated and any addition volume based on anticipated rainfall.
- Do not locate containment areas or devices where accidental release of the contained liquid can threaten health or safety, or discharge to watercourses, storm drain system, or to a receiving water.
- Capture all liquid wastes running off a surface that has the potential to affect the storm drainage system. Examples are: wash water and rinse water from cleaning walls or pavement.
- If the liquid waste is sediment laden, use a sediment trap or capture in a containment device and allow sediment to settle.
- Disposal of liquid wastes are subject to specific laws and regulations, or to requirements of other permits secured for the construction project.

Monitoring/Maintenance:

- Remove deposited solids from containment areas and containment systems as needed, and at the completion of the project.
- Inspect containment areas and containment systems routinely for damage, and repair as needed.

TRAINING AND SIGNAGE – NS-17

Application: Training of contractor and subcontractor personnel is an essential component to good stormwater management. Trained site personnel are more capable of managing materials to prevent spills, and implement control practices efficiently and correctly. This BMP presents general guidelines for personnel training including recommended signage requirements to inform personnel of stormwater-related information relevant to the site.

Design Guidelines: Personnel at all levels shall be trained in the components and goals of the permit.

Construction Specifications/Installation:

The measures below shall be followed to ensure the Plan is effectively implemented, BMP inspections are performed, BMP maintenance and repair are performed, and appropriate records are prepared and retained:

- Before beginning construction activities and periodically during construction, on-site personnel shall receive training for implementation of the Plan; performance of BMP inspection, maintenance, and repair; record keeping; and prevention of and response to non-stormwater discharges. Training shall be documented by the contractor.
- Training for individuals responsible for overseeing, revising, and amending the Plan shall be documented.
- All employees and contractors working onsite shall be trained by staff familiar with the Plan requirements before they shall be permitted to work at the site. Contractors shall be responsible for informing their subcontractors about EPSCP requirements.
- BMP drawings, trade water quality guidelines, fact sheets, or other specifications shall be copied and distributed to contractors and site personnel engaged in the activity in question and/or installation/maintenance of BMPs.
- The Plan, construction plans, public works standards, and Manual shall be kept on-site. Stormwater pollution prevention information shall be posted on-site, such as:
 - Job Site Clean-Up Required Everyday.
 - Directions to and identification of concrete and paint wash outs.
 - Erosion Prevention and Sediment Control Plan is in effect, and its location.

APPENDIX A

**Excerpts from the
Gresham Development Code
that Pertain to Erosion Prevention
and Sediment Control**

The authority of the city to regulate erosion prevention and sediment control is set forth in the City of Gresham Development Code (GDC; January 2004) at the time of this writing. The following sections are especially pertinent and are listed here for convenience only. It is the responsibility of the developer/site manager to ensure compliance with the most recent city code.

Section 9.0500 Grading and Drainage and Stormwater Quality Control Requirements

9.0514 Erosion Prevention and Sediment Control Measures During Construction

Unless otherwise approved, the following standards are adopted as minimum requirements for the purposes of minimizing or preventing erosion. The final program for soil stabilization may vary as site conditions and development warrant. These minimum guidelines are not intended to resolve all project soil erosion conditions. The applicant for a development permit is ultimately responsible for containing all soil on the project site and must recognize the potential for changing or unexpected site and weather conditions. The applicant for a development permit or, in the case of a land division, before the Notice to Proceed is issued, shall submit an erosion prevention and sediment control plan as part of their application utilizing appropriate best management practices (BMPs), per the Erosion Prevention and Sediment Control Manual (EPSC Manual). If necessary to meet the intent of this section, the applicant shall update or modify the erosion prevention and sediment control measures, per the EPSC Manual, as such conditions render existing measures ineffective.

- (A) The plans and specifications will demonstrate the minimization of stripping vegetation on the project site.
- (B) If top soil is to remain stockpiled during wet weather, seeding, mulching or other stabilization measures are required.
- (C) All areas which will, by necessity, be left bare after October 1 shall be seeded and mulched to a cover crop (e.g., cereal rye, annual rye grass, perennial rye grass). Mulching and mulching with landscaping may be a viable alternative to seeding. Seed and mulch shall be applied with a tackifier in areas in excess of 10% slope. If, by the date set forth in the EPSC Manual, seeding has not established itself to the point of being an effective erosion control measure, additional measures may be required. Regular inspection and maintenance, as necessary, is required to maintain the effectiveness of the erosion prevention and sediment control measures.
- (D) Means shall be devised to prevent sediment laden water from entering the public storm sewer system or natural watercourses. Use of approved filtration measures to prevent sediment transport from the site will be required.
- (E) In areas of concentrated flow, temporary diversion berms, chutes or downpipes and down drains sized for a two-year storm may be required for projects left incomplete during the winter months. Temporary check dams may be required for channels carrying sufficient amounts of water to cause channel scouring and erosion.
- (F) Temporary check dams may be required for channels carrying sufficient amounts of water to cause channel scouring and erosion.
- (G) All erosion prevention and sediment control measures shall be maintained, including replacement and repair as needed, as required by the EPSC Manual.

9.0515 Establishing Protective Vegetative Cover upon Completion of Final Grading

- (A) Vegetation is to be established as soon as practicable after completion of grading to minimize erosion. Prior to final project acceptance, the site shall be permanently stabilized with seed and mulch, or permanent landscaping. Seed and mulch shall be applied with a tackifier in areas in excess of 10% slope. In cases of a land division, temporary groundcover will be accepted on each lot where home construction will begin within 30 days of project completion.
- (B) All swales and channels shall be permanently stabilized prior to use as specified in the EPSC Manual.
- (C) Erosion control measures shall be continued after construction until the vegetative ground cover for the site is established and functioning such that erosion has ceased.
- (D) The developer will be responsible for all erosion prevention and sediment control for individual lots until ownership has changed.
- (E) In cases with developments with 1200-C permits, the developer is responsible for erosion prevention and sediment control until the 1200-C permit is terminated by the state.
- (F) Temporary sediment control measures shall be removed by the developer when permanent stabilization or landscaping has been installed and is functioning.

Section 5.0200 Hillside Physical Constraint Overlay District

5.0223 Minimizing Site Disturbance

The applicant shall show all site grading, clearing and other site disturbance including that proposed for rights-of-way, utilities, buildable areas and driveways, as described in Section 5.0210(D), Preliminary Grading Plan.

- (A) No more than 35% of the total site of the area exhibiting slopes of 15% or greater (before development), shall be graded, cleared or otherwise disturbed. Except that one additional percentage of land may be disturbed for each percentage of land dedicated to open space above the minimum required in Section 6.0324 (i.e., 40% [35%+5%] of the total site over 15% slope may be disturbed if a minimum of 30% [25%+5%] open space is dedicated). For individual single-family dwelling building permits, see Section 5.0202(B)(2)(a).

In order to meet this requirement, applicants are encouraged to pursue innovative site design techniques such as:

- Limiting grading on building lots only to that area needed for driveways and building pads;
- Limiting the total area of the site dedicated to roadways while maintaining adequate connectivity and providing for adequate emergency access consistent with the roadway standards;
- Locating roads on less steeply sloped areas to minimize the width of graded areas needed for roads;
- Designing and locating structures so that they fit into the contour of the hillside rather than altering the hillside to fit the structure;
- Using retaining structures as an alternative to banks of cuts and fills;
- Building designs, which require less grading, such as split-level and stair-stepping foundations and the use of piers;

- Placing structures as close as possible to the street so as to minimize driveway construction in the sloped areas; and
- Focusing development on slopes less than 15%.

(B) Hillside Grading and Drainage Control

All development on lands within the HPCD shall provide construction plans that conform to the following items:

- (1) All grading, retaining wall design, drainage, and erosion control for development on HPCD lands shall be designed by a Registered Civil Engineer in accordance with the recommendations and guidelines provided in the Soils and Geology Report, as approved by the Manager. All cuts, grading or fills shall conform to Chapter 70 of the Uniform Building Code. Erosion control measures shall conform to Section 9.0514.
- (2) For developments other than single family homes on individual lots, all grading, drainage improvements, or other land disturbances on slopes of 15% or greater, shall only occur from May 31 to October 1. Wet-weather erosion control measures shall be installed and functional by October 1. The time period for land disturbance activities may be extended (either earlier than May 31 or later than October 1) by the City's Engineer after approval by the Stormwater Manager or designee, based on the recommendations of the Soils and Geology Report, with the concurrence from the City's consulting engineer. The modification of dates shall be the minimum necessary, based upon evidence provided by the applicant, to accomplish the necessary project goals.
- (3) Revegetation requirements. Where required by this Section, all required revegetation of cut and fill slopes shall be installed prior to the issuance of a certificate of occupancy, acceptance of public facilities, or other time as determined by the Manager.
- (4) Inspections and Final Report. Prior to the acceptance of public facilities or issuance of a building permit for a structure, the developer's engineer of record shall provide a final report indicating that the approved grading, drainage, and erosion control measures were installed as per the approved plans, and that all scheduled inspections, as per Section 5.0210(C)(6), were conducted by the engineer of record periodically throughout the project.

5.0225 Trees and Vegetation

Trees and vegetation shall be maintained on site in order to provide protection against soil erosion and earth movement as well as to protect the aesthetic value of those hillside areas that may be highly visible to the surrounding community. Any proposed tree removal shall comply with the provisions of Section 9.1000, including no tree removal on slopes over 15% (before development) that results in clear cutting, as defined in Section 3.0100, except as follows:

- (A) The removal of existing trees with a circumference of 25 inches or greater shall be limited to and within 10 feet of those areas required for the grading of roads, driveways, utilities, and the preliminary grading area for building pads. Tree removal that is confined to the approved grading plan (up to the grading limitations of Section 5.0223(A)) shall not constitute "clear cutting" as defined in Section 3.0100.
- (B) A Vegetation/Revegetation Plan to stabilize slopes and minimize soil erosion is required based on the findings and recommendations in the Soils and Geology Report. The Vegetation/Revegetation Plan shall be prepared by a licensed Landscape Architect registered in the State of Oregon, and shall discuss any special measures proposed to protect water resources on or near the site for areas identified as

particularly highly susceptible to erosion. Temporary erosion control measures, as they relate to construction activity, shall be, at a minimum, consistent with the guidance and requirements presented in the City's Prevention and Sediment Control Manual, and current erosion control and slope stability engineering practices. Revegetated areas shall be continuously maintained until vegetation is established. The maintenance of the revegetation shall be included as part of the Public Facilities Maintenance Bond.

Section 5.0600 Water Quality Resource Area (WQRA) Overlay District

5.0602 Intent

The intent is to protect and improve water quality, to support designated beneficial water uses and to protect the functions and values of existing and newly established Water Quality Resource Areas, which include, but are not limited to:

- (A) Provide a vegetated corridor to separate protected water features from development;
- (B) Maintain or reduce stream temperatures;
- (C) Maintain natural stream corridors;
- (D) Minimize erosion, nutrient and pollutant loading into water;
- (E) Provide filtration, infiltration and natural water purification;
- (F) Stabilize slopes to prevent landslides contributing to sedimentation of water features.

5.0610 Development Standards

- (B) To the extent practicable, existing vegetation shall be protected and left in place. Those portions of the Water Quality Resource Area that are not proposed to be impacted by development shall be located and delineated on the site by flags, stakes, fencing or other means. Such markings shall be maintained until construction is completed.
- (C) Where existing vegetation has been removed, or the original land contours disturbed, the site shall be revegetated with native vegetation as listed in the Metro Native Plant List. The vegetation shall be established as soon as practicable. Nuisance plants (invasive non-native plants), as identified in the Metro Native Plant List, may be removed at any time. Interim erosion control measures such as mulching shall be used to avoid erosion on bare areas. Nuisance plants shall be replaced with non-nuisance plants by the next growing season.
- (E) Additions, alterations, rehabilitation and replacement of existing structures, roadways, driveways, accessory uses and other development that are not exempted by Section 5.0607 (E):
 - (1) The WQRA provisions shall apply to existing development that is nonconforming, in addition to any other applicable requirements of the Community Development Code.
 - (2) Additions, alterations, rehabilitation or replacement of existing structures, roadways, driveways, accessory uses and development shall not encroach closer to the Protected Water Feature than the existing location of the structure, roadway, driveway, accessory use or other development.
 - (3) Additions, alterations, etc. must meet City erosion control standards.

- (4) The project shall be conditioned to limit its disturbance and impact on the WQRA to the minimum extent necessary to achieve the proposed addition, alteration, restoration, replacement or rehabilitation.

APPENDIX B

**Soil Erosion Potential (RUSLE) and
Local Soil Characteristics**

Evaluation of Soil Erosion Potential

The erosion potential for critical soil areas can be evaluated using site factors and selected erosion prevention and sediment control BMPs. The most common method of evaluating erosion potential is to estimate annual erosion rates using the Revised Universal Soil Loss Equation (RUSLE), which is a semi-empirical equation based on 10,000 plot-years of data. RUSLE can be used to predict differences in natural erosion potential among various development sites, and to predict differences with and without erosion control BMPs.

REVISED UNIVERSAL SOIL LOSS EQUATION

$$A = R \times K \times LS \times C \times P$$

Where:

- A** = Annual rate of erosion in tons per acre per year
- R** = Rainfall factor
- K** = Soil erodibility
- L** = Length of slope
- S** = Slope steepness
- C** = Cover factor
- P** = Conservation practice factor

***In Gresham, a construction site
shall not exceed the average
daily amount of soil loss
predicted by the RUSLE.***

The Agricultural Research Service (ARS) and Natural Resources Conservation Service (NRCS) are sections of the United States Department of Agriculture (USDA) that have developed a computer application (RUSLE2) to estimate erosion using the RUSLE equation. RUSLE2 uses methods developed over the past century to estimate soil loss, sediment yield, and sediment characteristics from rill and interrill (sheet and rill) erosion caused by rainfall and its associated overland flow. RUSLE2 relies on user input of site specific factors that represent the effects of climatic erosivity, soil erodibility, topography, cover management, and support practices to estimate erosion.

The RUSLE2 computer program, RUSLE databases, a tutorial that describes program mechanics, a slide set that provides an overview of RUSLE2, example calculations, and other supporting information are available for download from any of the following RUSLE2 internet sites:

- University of Tennessee at <http://bioengr.ag.utk.edu/RUSLE2/>
- USDA-ARS at <http://www.sedlab.olemiss.edu/RUSLE/>
- USDA- NRCS at <ftp://fargo.nserl.purdue.edu/pub/RUSLE2/>

Each site factor that influences erosion (i.e., variable in the RUSLE) is described below.

Rainfall/Climate (R)

- Climate, and particularly rainfall intensity and duration are directly related to erosion:
- Droplet size is important from the aspect of splash erosion
- Other considerations include: storm patterns, types of vegetation native to the area, vegetation morphology and growth characteristics, and average annual soil temperatures

Soil Erodibility (K)

Soil erodibility is the propensity for soil particles to become detached by actions of water or wind. The K factor:

- Is a function of soil texture, organic matter content, soil structure and permeability
- Is expressed as numerical values in USDA/NRCS tables

Flow Path Length and Slope (LS)

- The degree to which length and slope (LS Factor) play in erosion can be calculated using USDA/NRCS charts
- Slope Length: distance along flow path to a point where deposition is first likely to occur
- Slope Steepness: ratio of horizontal distance to vertical rise (e.g., 3:1 slope); percentage (e.g., 33 percent slope); or degrees (18 degree slope)

In general:

- The effect of flow path length is not as great as effect of slope steepness
- Long uninterrupted slopes and especially long steep slopes (2:1 horizontal: vertical or greater) should not be constructed
- Long slopes should be shortened by creating contour diversions or benches every 25 feet.
- A convex slope shape increases runoff and magnifies slope erosion
- A concave slope shape enhances infiltration and reduces erosion

Aspect or orientation of slope is important with respect to:

- Vegetation establishment
- Moisture content

Cover

The rate of erosion is related to the amount of permanent or temporary cover. The functions of cover are to:

- Reduce rainfall impact on soil
- Reduce surface water velocities
- Enhance infiltration
- Filter sediment in surface runoff
- Retain soil particles in place and reinforce soil structure
- Promote permanent vegetation establishment

Conservation Practices (P)

Conservation practices are controllable, imaginative, experience-driven, and interactive factors such as slope roughening perpendicular to the direction of runoff. For the most part, they can:

- Enhance the factors of cover and soil texture
- Mitigate the influence of rainfall and runoff
- Modify velocity flow path length and steepness

Soil Survey Information

The USDA/NRCS Multnomah County Area Soil Survey tables contain valuable information to estimate erosion potential using RUSLE, and to assist with design and selection of site BMPs. The Multnomah County Area Soil Survey (USDA/NRCS, OR051), including maps and tables, is accessible on the web at: http://www.or.nrcs.usda.gov/pnw_soil/or_data.html. Additional soil information available online may be found at the same web link.

The county soil survey contains three tables of particular interest: Physical Properties of the Soils; Water Features; and Engineering Index Properties. Relevant information available from each of these tables is discussed below.

Soil Survey Table J1b—Physical Properties of Soils

Erosion factors are shown in Table J1b (presented below for Multnomah County Soils) and include the K factor (labeled as K_f in Table J1b), the K_w factor and the T factor. The erosion factor K_f indicates the erodibility of the fine-earth fraction, or the material less than 0.08 inch in size. Erosion factor K_w indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments. Value listed for K_f factor should be used for factor K in the Revised Universal Soil Loss Equation (RUSLE) as discussed below.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. K is one of six factors used in RUSLE to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability.

- **The Soil Erodibility Factor K (K_f in Table J1b)** is used in RUSLE and indicates the susceptibility of the fine-earth fraction, or the material less than 0.08 inch in size, of the soil to sheet and rill erosion by rainfall. Rocks and rock fragments in the soil profile are not considered (hence why the factor K_w is not used in the RUSLE equation). Values for K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by rainfall.
- **Erosion factor T** is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. Values of T range from 1 to 5 tons/acre/year and are based on depth of soil to bedrock and the type of bedrock. The T factor is not used for construction site erosion.
- **Wind erodibility groups** are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

Group Number	Soil Description
1	Coarse sands, sands, fine sands, and very fine sands.
2	Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3	Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
4L	Calcareous loams, silt loams, clay loams, and silty clay loams.
4	Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5	Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6	Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7	Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8	Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

- **Wind erodibility index** is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion and is used in the Wind Erosion Equation (WEQ) and is based on soil texture and the relationship of dry soil aggregates greater than 0.03 inch to potential erosion rates of 0 to 310 tons/acre/year from a wide, bare field. This value applies only to the surface layer. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Soil Survey Table K1—Water Features

Table K1 (presented below for Multnomah County soils) gives estimates of various water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

- **Group A.** Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B.** Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C.** Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

- **Group D.** Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

The months in the table indicate the portion of the year in which the feature is most likely to be a concern.

- **Wetness** refers to a saturated zone in the soil. Table K1 indicates, by month, depth to the top (upper limit) and base (lower limit) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.
- **Ponding** is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. Table K1 indicates surface water depth and the duration and frequency of ponding. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, long if 7 to 30 days, and very long if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. None means that ponding is not probable; rare that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); occasional that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and frequent that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).
- **Flooding** is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.
- **Duration and frequency** are estimated. Duration is expressed as extremely brief if 0.1 hour to 4 hours, very brief if 4 hours to 2 days, brief if 2 to 7 days, long if 7 to 30 days, and very long if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. None means that flooding is not probable; very rare mean that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); rare that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); occasional means that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); frequent means that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and very frequent means that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Soil Survey Table H—Engineering Index Properties

Table H (presented below for Multnomah County soils) provides the engineering classifications and the range of index properties for the layers of each soil in the survey area.

- **Depth** to the upper and lower boundaries of each layer is indicated.
- **Texture** is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 0.08 inch in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, “gravelly.”
- **Classification of the soils** is determined according to the Unified soil classification system (ASTM, 1998) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1998).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table R.

- **Rock fragments** larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.
- **Percentage (of soil particles) passing designated sieves** is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 0.19, 0.08, 0.02, and 0.003 inch, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.
- **Liquid limit and plasticity index** (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of particle-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is generally omitted in the table.

Soil Survey Information

If you need additional information regarding site-specific soils, contact your state or local NRCS District Conservationist or soil scientist:

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APPENDIX C
Acronyms and Terms

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AC	acre
ACBs	articulated concrete blocks
AM	arbuscular mycorrhizae
ASTM	American Society for Testing and Materials
BFM	Bonded fiber matrix
BMP	Best Management Practice
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEQ	Department Environmental Quality
EC	erosion control
ECB	erosion control blanket
ECM	ectomycorrhizae
EM	ectomycorrhizae
EP	erosion prevention
EPA	United States Environmental Protection Agency
EPCM	Erosion and Pollution Control Manager
EPSCP	Erosion Prevention and Sediment Control Plan
ESA	Endangered Species Act
H:V	horizontal to vertical
IDF	intensity-duration-rainfall
K	potassium
lbs/acre	pounds per acre
LS	length and slope
N	nitrogen
NCDC	National Climatic Data Center
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NPS	non-point sources
NS	non-stormwater pollution control
OAR	Oregon Administrative Rule
P	phosphorus
PAM	poly-acrylamide
PLS	pure live seed

RC	runoff control
RECP	rolled erosion control product
RUSLE	Revised Universal Soil Loss Equation
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TRM	turf reinforcement mat
UIC	underground injection control
USDA	United States Department of Agriculture
VAM	vesicular-arbuscular mycorrhizae

Terms

Adsorption	The adhesion of a substance to the surface of a solid or liquid. Heavy metals such as zinc and lead often adsorb onto particles.
Alluvial Soils	Soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes.
Annual Storm	The highest peak storm discharge that is expected in any given year.
Apron	A pad of non-erosive material designed to prevent scour holes developing at the outlet ends of culverts, outlet pipes, grade stabilization structures, and other water-control devices.
Aquifer	An underground, porous, water-bearing, geological formation. The term is generally restricted to materials capable of yielding an appreciable supply of water.
Base Flow	Stream discharge derived from groundwater sources as differentiated from surface runoff. Sometimes considered to include flows from regulated lakes or reservoirs.
Bedrock	The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.
Berm	A constructed barrier of compacted earth.
Best Management Practices (BMPs)	Physical, structural, and/or managerial practices employed to avoid or mitigate damage or potential damage from the contamination or pollution of surface waters or wetlands. Structural BMPs are actual physical installations; procedural/managerial BMPs, include good housekeeping and employee training.
Catch Basin	A grated inlet, curb opening, or combination inlet, with or without a sump, which admits stormwater to a sewer or subdrain.
Channel	A natural stream or excavated ditch that conveys water.
Channel Stabilization	Protecting the sides and bed of a channel from erosion by controlling flow velocities and flow directions using jetties, drops or other structures and/or by lining the channel with a suitable liner such as vegetation, riprap, concrete or other similar material.
Check Dam	A small dam constructed in a gully or other small watercourse to decrease flow velocity, minimize channel scour and promote sediment deposition.
Clay	(1) Soil fraction consisting of particles less than 0.00008 inch in diameter. (2) A soil texture class, which is dominated by clay or at least has a larger proportion of clay than either silt or sand.
Cohesion	The capacity of a soil to resist shearing stress, exclusive of functional resistance.
Cohesive Soil	A soil that, when unconfined, has considerable strength when air-dried and significant strength when saturated.
Coir	Fiber made from coconut husks.
Compost	Organic residue or a mixture of organic residues and soil that has undergone biological decomposition until it has become relatively stable humus.

Conventional Pollutants	Contaminants (other than nutrients) such as sediment, oil, and vehicle fluids.
Contour	An imaginary line on the surface of the earth connecting points of the same elevation.
Cut	Portion of land surface or area from which earth has been removed or will be removed by excavating the depth below the original ground surface to the excavated surface.
Cut-and-Fill	Process of earth grading by excavating part of a higher area and using the excavated material for fill to raise the surface of an adjacent lower area.
Cutoff Trench	A long, narrow excavation (keyway) constructed along the center line of a dam, dike, levee or embankment and filled with relatively impervious material intended to reduce seepage of water through porous strata.
Design Highwater	The elevation of the water surface at peak flow conditions of the design flood.
Design Storm	Selected storm of a given frequency used for designing a design storm system. Hypothetical storm derived from intensity-duration-frequency curves. A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff in order to analyze existing drainage, design new drainage facilities or assess impacts of a proposed project on surface water flow.
Detention	The storage and subsequent release of excess stormwater runoff to control peak discharge rates prior to discharge to the storm sewer or natural drainageway.
Detention Facility	A facility designed to receive and hold stormwater and release it at a slower rate, usually over a number of hours. The full volume of stormwater that enters the facility is eventually released.
Detention Time	The theoretical time required to displace the contents of a tank or unit at a given rate of discharge (volume divided by rate of discharge).
Dewatering	The removal of water temporarily impounded in a holding basin.
Dike	An embankment to confine or control water, often built along the banks of a river to prevent overflow of lowlands; a levee.
Discharge	Usually the rate of water flow; a volume of fluid passing a point per unit time commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.
Dispersion, Soil	The breaking down of fine soil aggregates into individual particles, resulting in single-grain structure. Ease of dispersion influences the erodibility of soils. Generally speaking, the more easily dispersed the soil, the more erodible it is.
Diversion	A channel with a supporting ridge on the lower side constructed at the top, across, or at the bottom of a slope for the purpose of controlling surface runoff.
Diversion Dike	A barrier built to divert surface runoff.
Drain	A buried slotted or perforated pipe or other conduit (subsurface drain) or a ditch (open drain) for carrying off surplus groundwater or surface water.
Drainage	The removal of excess surface water or groundwater from land by means of ditches or subsurface drains.

Drainage Facilities	Pipes, ditches, detention basins, creeks, culvert bridges, etc., used singularly or in combination with each other for the purpose of conveying or storing stormwater run-off.
Drainageway	A natural or artificial depression that carries surface water to a larger watercourse or outlet such as a river, lake, or bay.
Drop Inlet	Overall structure in which the water drops through a vertical riser connected a discharge conduit or storm sewer.
Earth Dam	Dam constructed of compacted suitable soil materials.
Embankment	A man-made deposit of soil, rock, or other material often used to form an impoundment.
Emergency Spillway	Usually a vegetated earth channel used to safely convey flood discharges around an impoundment structure.
Energy Dissipater	A device used to reduce the energy of flowing water to prevent erosion.
Environment	The sum total of all the external conditions that may act upon a living organism or community to influence its development or existence.
Erodibility	Susceptibility to erosion.
Erosion	The wearing away of the land surface by water, wind, ice, gravity, or other geological agents. The following terms are used to describe different types of water erosion:
<i>Accelerated erosion</i>	Erosion much more rapid than normal or geological erosion, primarily as a result of the activities of man.
<i>Channel erosion</i>	The erosion process whereby the volume and velocity of flow wears away the bed and/or banks of a well-defined channel.
<i>Gully erosion</i>	The erosion process whereby runoff water accumulates in narrow channels and, over relatively short periods, removes the soil to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.
<i>Rill erosion</i>	An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils.
<i>Splash erosion</i>	The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.
<i>Sheet erosion</i>	The gradual removal of a fairly uniform layer of soil from the land surface by runoff water.
Erosion Prevention and Sediment Control	Any temporary or permanent measures taken to reduce erosion, control siltation and sedimentation, and ensure that sediment-laden water does not leave a site.
Erosion Prevention and Sediment Control Plan	Plans, specifications, and BMP details intended to prevent and control erosion and sediment related to the project construction activities.
Evapotranspiration	The combined loss of water from an area by evaporation from the soil surface and by transpiration of plants.
Filter Fabric	A woven or non-woven, water permeable material generally made of synthetic products such as polypropylene and used in erosion and sediment control

	applications to trap sediment or prevent the movement of fine soil particles. Often used instead of a filter blanket.
Flood Peak	The highest stage or greatest discharge attained by a flood event. Thus, peak states or peak discharge.
Floodplain	The lowland that borders a stream and is subject to flooding when the stream overflows its banks.
Flood Stage	The stage at which overflow of the natural banks of a stream begins.
Floodway	A channel that is natural, excavated, or bounded by dikes and levees, used to carry flood flows.
Frequency of Storm (Design Storm Frequency)	The anticipated period in years that will elapse before another storm of equal intensity and/or total volume will recur: a 10-year storm can be expected to occur on the average once very 10 years.
Gabion	A wire mesh cage, usually rectangular, filled with rock and used to protect channel banks and other sloping areas from erosion.
Gauge	Device for measuring precipitation, water level, discharge, velocity, pressure, temperature, etc., e.g., a rain gauge. A measure of the thickness of metal, e.g., diameter of wire or wall thickness of steel pipe.
Geotextile	Any permeable textile used with foundation, rock, earth or any other geotechnical engineering-related material as an integral part of a human-made project, structure or system.
Grade	<ol style="list-style-type: none"> (1) The degree of inclination of a road or slope. (2) The finished surface of canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared to a design elevation for the support of construction such as paving or the laying of a conduit. (3) To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation, or other land area to a smooth, even condition.
Grade Stabilization Structure	A structure for the purpose of stabilizing the grade of a gully or other watercourse, thereby preventing further head-cutting or lowering of the channel bottom.
Gradient	Change of elevation, velocity, pressure, or other characteristics per unit length; slope.
Grading	The cutting and/or filling of the land surface to a desired slope or elevation.
Grass	A member of the botanical family Gramineae, characterized by blade-like leaves that originate as a sheath wrapped around the stem.
Grassed Waterway	A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to safely conduct surface water from an area.
Ground Cover	Low-growing, spreading plans useful for low maintenance landscape areas.
Habitat	The environment in which the life needs of a plan or animal are supplied.
Hazardous Materials	Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or

	potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.
Heavy Metals	Metals having a high specific gravity, present in municipal and industrial wastes, that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel and zinc.
Hydrologic Cycle	The circuit of water movement from the atmosphere to the earth and back to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.
Hydrology	The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.
Impervious	A surface, which water, can not easily penetrate. Can include graveled surface as well as paved surfaces.
Infiltration	The percolation of water into the ground.
Inlet	The point at which stormwater from impervious surfaces or conveyance piping enters a stormwater management facility. The term “inlet” can also be used in reference to a catch basin (see definition).
Invert	The inside bottom of a culvert or other conduit.
Land Capability	The suitability of land for use. Land capability classification involves consideration of: (1) the risks of land damage from erosion and other causes, and (2) the difficulties in land use owing to physical land characteristics, including climate.
Land Use Controls	Methods for regulating the uses to which a given land area may be put, including such things as zoning, subdivision regulation, and floodplain regulation.
Loam	A soil textural classification in which the proportions of sand, silt and clay are well balanced. Loams have the best properties for cultivation of plants.
Mean Velocity	The average velocity of a stream flowing in a channel or conduit at a given cross-section or in a given reach. It is equal to the discharge divided by the cross-section area of the reach.
Mitigation	Means, in the following order of importance: <ol style="list-style-type: none">1. Avoiding the impact altogether by not taking a certain action or part of an action.2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts.3. Rectifying the impact by repairing, rehabilitating or restoring the affected environment.4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action and5. Compensation for the impact by replacing, enhancing, or providing substitute resources or environments.
Mulch	A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant

	cover, and minimizes temperature fluctuations.
Natural Grade	The grade of the land in an undisturbed state.
Non-point Source Pollution	Pollution that enters a water body from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.
Non-Stormwater Discharge	Any discharge to the public stormwater system that is not entirely stormwater.
Normal Depth	Depth of flow in an open conduit during uniform flow for the given conditions.
NPDES	National Pollutant Discharge Elimination System. The part of the federal Clean Water Act, which requires permits for point and non-point source discharges.
Nutrients	Essential chemicals for plant and animal growth. Excessive amounts can lead to water quality degradation and algae blooms. Some nutrients are toxic at high concentrations.
Open Drain	Natural watercourse or constructed open channel that conveys drainage water.
Outfall	The point at which collected concentrated stormwater is discharged, generally from a pipe(s), from a project site to an open drainage element such as a ditch, channel, swale, stream, river, pond, lake or wetland.
Outlet	Point of water disposal from a stream, river, lake tidewater, or artificial drain.
Outlet Channel	A waterway constructed or altered primarily to carry water from man made structures, such as smaller channels, tiles, lines, and diversions.
Peak Run-off	The maximum stormwater run-off rate (cfs) determined for the design storm, or design rainfall intensity.
Permeability	A generic term for the ability of a material to conduct a fluid.
Permeable Soils	Soil materials with filtration rate of 10 minutes per inch or better. Such soils allow infiltration and reduce or eliminate surface and stormwater runoff. Classified as SCS (Soil Conservation Services) Type A.
Permeability Rate	<p>The rate at which water will move through a saturated soil. Permeability rates are classified as follows:</p> <ul style="list-style-type: none"> • Very slow – Less than 0.06 inch per hour • Slow – 0.06 to 0.20 inch per hour • Moderately slow – 0.20 to 0.63 inch per hour • Moderate – 0.63 to 2.0 inches per hour • Rapid – 6.3 to 20.0 inches per hour • Very rapid – More than 20.0 inches per hour
Permittivity	For a geotextile, the volumetric flow rate of water per unit cross-section area, per unit head, under laminar flow conditions, in the normal direction through the fabric.
Point Source	Any discernible, confined and discrete conveyance, including but not limited to, any pipe ditch, channel, tunnel, conduit, well, discrete fissure, container, roller stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.
Point Source Pollutants	Pollution, which enters a water body resulting from discernible confined or

	discrete conveyances.
Pollutant	Anything which causes or contributes to pollution.
Pervious	Allowing movement of water.
Porosity	The volume of pore space in soil or rock.
Practicable	Available and capable of being done as determined by the Stormwater Division Manager, after taking into consideration cost, existing technology, and logistics in light of overall project purpose, referred to in the Clean Water Act as “Maximum Extent Practicable”.
pH	A numerical measure of hydrogen ion activity. The neutral point is pH 7.0. All pH values below 7.0 are acid and all above 7.0 are alkaline.
Rainfall Intensity	The rate at which rain is falling at any given instant, usually expressed in inches per hour.
Rational Method	A means of computing storm drainage flow rates, Q , by use of the formula $Q=CIA$, where C is coefficient describing the physical drainage area, I is the rainfall intensity and A is the area.
Receiving Stream	The body of water into which runoff or effluent is discharged.
Retention	The process of collecting and holding surface and stormwater run off with no surface outflow from a developed property.
Retention Facility	A facility designed to receive and hold stormwater runoff. Rather than storing and releasing the entire runoff volume, retention facilities permanently retain water on-site, where it infiltrates, evaporates, or is absorbed by surrounding vegetation. In this way, retention facilities reduce the total volume of excess water released to downstream conveyance facilities.
Riparian	Pertaining to banks of streams, wetlands, lakes or tide waters.
Riser	The inlet portions of a drop inlet spillway that extends vertically from the pipe conduit barrel to the water surface.
Runoff	That portion of precipitation that flows from drainage area on the land surface, in open channels or in stormwater conveyance systems.
Salmonid	A member of the fish family <i>Salmonidae</i> . Includes Chinook, coho, chum, sockeye and pink salmon, cutthroat, steelhead, rainbow, Dolly varden, brook, kokanee and whitefish.
Sand	(1) Soil particles between 0.002 and 0.079 inch in diameter. (2) A soil textural class inclusive of all soils which are at least 70% sand and 15% or less clay.
Saturation	In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.
Scour	The clearing and digging action of flowing water, especially the downward erosion caused by stream water in sweeping away mud and silt from the streambed and outside bank of a curved channel.
Sediment	Fragmented material originated from weathering and erosion of rocks and unconsolidated deposits. The material is transported by, suspended in, or

	deposited by water.
Sedimentation	Deposition of erosional debris-soil sediment transported by water from a higher elevation to an area of lower gradient where sediments are deposited as a result of slack water.
Sediment Delivery Ratio	The fraction of the soil eroded from upland sources that actually reaches a stream channel or storage reservoir.
Sediment Discharge	The quantity of sediment, measured in dry weight or by volume, transported through a stream cross-section in a given time. Sediment discharge consists of both suspended load and bedload.
Seedbed	The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.
Seedling	A young plant grown from seed.
Sheet Erosion	Relatively uniform removal of soil from an area without the development of conspicuous water channels.
Sheet Flow	Relatively uniform flow over a plan surface without concentration of water into conspicuous channels.
Shoot	The above-ground portion of a plant.
Silt	Fine textured soil particles, including clay and sand, as differentiated from coarse particles of sand and gravel.
Siltation	Process by which a river, lake or other water body becomes clogged with sediment. Siltation can clog gravel beds and prevent successful salmon spawning.
Slope	Degree of deviation of a surface from the horizontal; measured as a numerical ratio or percent. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), e.g., H:V = 2:1.
Soil	The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.
Soil Horizon	A horizontal layer of soil that, through processes of soil formation, has developed characteristics distinct from the layers above and below.
Soil Profile	A vertical section of the soil from the surface through all horizons.
Soil Stabilization	Use of rock-lining, vegetation or other methods to prevent soil movement when loads are applied to the soil.
Soil Structure	The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking; some types are crumb structure, block structure, platy structure, and columnar structure.
Soil Texture	The physical structure or character of soil determined by the relative proportions of the soil separates (sand, silt and clay) of which it is composed.
Spillway	A passage such as a paved apron or channel for surplus water over or around or through a dam or similar structure. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, whether manually or automatically controlled, to regulate the discharge of excess water.
Storm Frequency	The statistical time interval between major storms of predetermined intensity and runoff volumes for which storm sewers and other structures are designed and

	constructed to handle hydraulically without surcharge or backflood.
Storm Sewer	A sewer that carries stormwater, surface drainage, street wash and other wash waters, but excludes sewage and industrial wastes. Also called a storm drain.
Stormwater	Surface runoff and drainage associated with rain/storm events and snowmelt.
Stormwater Facility	A constructed component of a stormwater drainage system, designed or constructed to perform particular function, or multiple functions. Stormwater facilities include pipes, swales, ditches, culverts, street gutters, detention basins, retention basins, constructed wetlands and other.
Streambanks	The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.
Subsoil	The B-horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below which roots do not normally grow.
Subsurface Drain	A pervious backfilled trench usually containing stone and perforated pipe for intercepting groundwater or seepage.
Surface Runoff	Precipitation that falls onto the surfaces of roofs, streets, the ground, etc., and is not absorbed or retained by that surface, but collects and runs off.
Suspended Solids	Organic or inorganic particles suspended in and carried by water, sand, mud, clay as well as solids.
Swale	A broad, bottomed, shallow, vegetation lined channel, which allows for reduced flow velocity and filtration of stormwater, generally with flow depths less than one foot.
Time of Concentration (T of C)	The time it takes stormwater runoff to travel from the most distant point on a particular site or drainage basin to a particular point of interest.
Toe of Slope	The base or bottom of a slope at the point where the ground surface abruptly changes to a significantly flatter grade.
Topography	General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.
Topsoil	The dark-colored surface layer of A horizon of a soil. When present it ranges in depth from a fraction of an inch to 2 or 3 feet; equivalent to the plow layer of cultivated soils. Commonly used to refer to the surface soil layer(s), enriched in organic matter and having textural and structural characteristics favorable for plant growth.
Total Suspended Solids (TSS)	Matter suspended in stormwater excluding litter, debris, and other gross solids exceeding 1 millimeter in diameter.
Toxicity	The characteristics of being poisonous or harmful to plant animal life; the relative degree or severity of the characteristic.
Trash Rack	A structural device used to prevent debris from entering a pipe spillway or other hydraulic structure.
Turbidity	Is caused by silt and clay particles, particles smaller than 0.0008 inch, suspended in water. Measurement of turbidity can be done by turbidimeter which measures light-beam scatter caused by small suspended particles and converts it to NTU

	(nephelometric turbidity unit).
Turf	Surface soil supporting a dense growth of grass and associated root mat.
Vegetative Stabilization	Protection of erodible or sediment-producing areas with: <ul style="list-style-type: none"> • Permanent seeding, producing long-term vegetative cover, • Short-term seeding, producing temporary vegetative cover, or • Sodding, producing areas covered with a turf of perennial sod-forming grass.
Watercourse	A channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. Watercourses may be either natural or artificial.
Water Quality	A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.
Water Resources	The supply of groundwater and surface water in a given area.
Watershed Area	All land and water within the confines of a drainage divide.
Water Table	The free surface of the groundwater. That surface subject to atmospheric pressure under the ground, generally rising and falling with the season, or from other conditions such as water withdrawal.
Weir	Device for measure or regulating the flow of water.
Wet Pond	A facility treating stormwater by utilizing a permanent pool of water to remove conventional pollutants from runoff. Treatment mechanisms include sedimentation, biological uptake and plant filtration.
Wet Weather Season	Defined for the purposes of construction and development in the City of Gresham as the period between October 1 st and the following June 1 st .
Wetlands	Those lands adjacent to watercourses or isolated therefrom which may normally or periodically be inundated by the waters from the watercourse or the drainage waters from the drainage basin which it is located. These include swamps, bogs, sinks, marshes, and lakes, all of which are considered to be part of the watercourse and drainage system of the City and shall include the headwater areas where the watercourse first surfaces. They may be, but are not necessarily, characterized by special soils such as peat, muck, and mud.

APPENDIX D

Conversion and Reference Tables

Metric Conversion Tables

Measurement in:	From English Units:	To Metric Units:	Multiply By
Length	inch (in)	millimeter (mm)	25.40
	foot (ft)	meter (mm)	0.3048
	yard (yd)	meter (mm)	0.9144
	mile (mi)	kilometer (km)	1.609
Area	in ²	mm ²	645.2
	ft ²	m ²	0.0929
	yd ²	m ²	0.8361
	mi ²	km ²	2.590
	acre	hectare (ha)	0.4047
	acre	m ²	4047

Quantity	From SI Units	To English Units	Divide By
Length	km	mile	1.609
	m	yard	0.9144*
	m	foot	0.3048*
	mm	inch	25.4*
Area	km ²	square mile	2.59
	m ²	acre	4047
	hectare	acre	0.404
	m ²	square yard	0.836
	m ²	square foot	0.092
	mm ²	square inch	645.2

Abbreviations

L	liter
ha	hectares
kg	Kilogram=1x10 ³ grams
m	meter
km	kilometer=1x10 ³ meters
mm	millimeter

Slope Conversion Table

Run:Rise	% Grade	Angle Degree
100:1	1.0	0.6
90:1	1.1	0.6
80:1	1.3	0.7
70:1	1.4	0.8
60:1	1.7	1.0
50:1	2.0	1.1
40:1	2.5	1.4
35:1	2.9	1.6
30:1	3.3	1.9
25:1	4.0	2.3
20:1	5.0	2.9
19:1	5.3	3.0
18:1	5.6	3.2
17:1	5.9	3.4
16:1	6.3	3.6
15:1	6.7	3.8
14:1	7.1	4.1
13:1	7.7	4.4
12:1	8.3	4.8
11:1	9.1	5.2
10:1	10.0	5.7
9:1	11.1	6.3
8:1	12.5	7.1
7:1	14.3	8.1
6:1	16.7	9.5
5:1	20.0	11.3
4:1	25.0	14.0
3:1	33.3	18.4
2:1	50.0	26.6
1:1	100.0	45.0
How to calculate percent slope:	$\frac{\text{Rise or (v) vertical change elevation (feet)}}{\text{Run or (h) horizontal distance (feet)}} * 100$	
Divide rise by run, and multiply by 100, e.g.,	$\frac{15 \text{ vertical feet}}{45 \text{ horizontal feet}} * 100 = 0.30 * 100 = 30\%$	

Seed or Fertilizer Hydraulic Application

Application Load (W _{sf})	Area of Coverage (A)													
	Application Rates of Pure Live Seed (R _{sf})													
	20 lb/acre		40 lb/acre		60 lb/acre		80 lb/acre		100 lb/acre		200 lb/acre		400 lb/acre	
Pounds	acre	ft ²	acre	ft ²	acre	ft ²	acre	ft ²	acre	ft ²	acre	ft ²	acre	ft ²
10	0.50	21,780	0.25	10,890	0.17	7,260	0.13	5,445	0.10	4,356	0.05	2,178	0.03	1,089
20	1.00	43,560	0.50	21,780	0.33	14,520	0.25	10,890	0.20	8,712	0.10	4,356	0.05	2,178
30	1.50	65,340	0.75	32,670	0.50	21,780	0.38	16,335	0.30	13,068	0.15	6,534	0.08	3,267
40	2.00	87,120	1.00	43,560	0.67	29,040	0.50	21,780	0.40	17,424	0.20	8,712	0.10	4,356
50	2.50	108,900	1.25	54,450	0.83	36,300	0.63	27,225	0.50	21,780	0.25	10,890	0.13	5,445
60	3.00	130,680	1.50	65,340	1.00	43,560	0.75	32,670	0.60	26,136	0.30	13,068	0.15	6,534
70	3.50	152,460	1.75	76,230	1.17	50,820	0.88	38,115	0.70	30,492	0.35	15,246	0.18	7,623
80	4.00	174,240	2.00	87,120	1.33	58,080	1.00	43,560	0.80	34,848	0.40	17,424	0.20	8,712
90	4.50	196,020	2.25	98,010	1.50	65,340	1.13	49,005	0.90	39,204	0.45	19,602	0.23	9,801
100	5.00	217,800	2.50	108,900	1.67	72,600	1.25	54,450	1.00	43,560	0.50	21,780	0.25	10,890
120	6.00	261,360	3.00	130,680	2.00	87,120	1.50	65,340	1.20	52,272	0.60	26,136	0.30	13,068
140	7.00	304,920	3.50	152,460	2.33	101,640	1.75	76,230	1.40	60,984	0.70	30,492	0.35	15,246
160	8.00	348,480	4.00	174,240	2.67	116,160	2.00	87,120	1.60	69,696	0.80	34,848	0.40	17,424
180	9.00	392,040	4.50	196,020	3.00	130,680	2.25	98,010	1.80	78,408	0.90	39,204	0.45	19,602
200	10.00	435,600	5.00	217,800	3.33	145,200	2.50	108,900	2.00	87,120	1.00	43,560	0.50	21,780
220	11.00	479,160	5.50	239,580	3.67	159,720	2.75	119,790	2.20	95,832	1.10	47,916	0.55	23,958
240	12.00	522,720	6.00	261,360	4.00	174,240	3.00	130,680	2.40	104,544	1.20	52,272	0.60	26,136
260	13.00	566,280	6.50	283,140	4.33	188,760	3.25	141,570	2.60	113,256	1.30	56,628	0.65	28,314
280	14.00	609,840	7.00	304,920	4.67	203,280	3.50	152,460	2.80	121,968	1.40	60,984	0.70	30,492
300	15.00	653,400	7.50	326,700	5.00	217,800	3.75	163,350	3.00	130,680	1.50	65,360	0.75	32,670

"Application Load" is in Pure Live Seed.

Gross weight of seed can be converted by the Pure Live Seed (PLS) Rate [%Purity x %Germination = %PLS; W_{sf} = Gross Weight x %PLS]

Wood Fiber Mulch Hydraulic Application

2,000 lb/acre Application Rate (R_{wf})				
Wood Fiber	Water Required for Application		Area of Coverage (A)	
(W_{wf})	Average (V_{wa})	Maximum (V_{wm})		
	40 lbs mulch / 100 gal water	50 lbs mulch / 100 gal water		
Pounds	Gallons ¹	Gallons ¹	ft ²	Acres
500	1,250	1,000	10,890	0.25
600	1,500	1,200	13,068	0.30
700	1,750	1,400	15,246	0.35
800	2,000	1,600	17,424	0.40
900	2,250	1,800	19,602	0.45
1,000	2,500	2,000	21,780	0.50
1,100	2,750	2,200	23,958	0.55
1,200	3,000	2,400	26,136	0.60
1,300	---	2,600	28,314	0.65
1,400	---	2,800	30,492	0.70
1,500	---	3,000	32,670	0.75

2,500 lb/acre Application Rate (R_{wf})				
Wood Fiber	Water Required for Application		Area of Coverage (A)	
(W_{wf})	Average (V_{wa})	Maximum (V_{wm})		
	40 lbs mulch / 100gal water	50lbs mulch / 100gal water		
Pounds	Gallons ¹	Gallons ¹	ft ²	Acres
500	1,250	1,000	8,712	0.20
600	1,500	1,200	10,454	0.24
700	1,750	1,400	12,197	0.28
800	2,000	1,600	13,939	0.32
900	2,250	1,800	15,682	0.36
1,000	2,500	2,000	17,424	0.40
1,100	2,750	2,200	19,166	0.44
1,200	3,000	2,400	20,909	0.48
1,300	---	2,600	22,651	0.52
1,400	---	2,800	24,394	0.56
1,500	---	3,000	26,136	0.60

¹ Largest typical hydroseeding equipment has a 3,000 gallon working volume.

Hydraulic Applications

Seed or Fertilizer Hydraulic Application

Area of Coverage

$$A \text{ (acre)} = (W_{sf} / R_{sf})$$
$$A \text{ (ft}^2\text{)} = (W_{sf} / R_{sf}) * (43,560 \text{ ft}^2\text{/acre)}$$

Seed or Fertilizer Application Rates (lb/acre)	R_{sf}
Weight or Mass of Seed or Fertilizer (lbs)	W_{sf}
Area of Coverage (ft ²) & (acres)	A

Wood Fiber Mulch Hydraulic Application

Average Water Required for Application

$$V_{wa} \text{ (gal)} = (W_{wf}) / (40 \text{ lbs mulch} / 100 \text{ gal water})$$

Maximum Water Required for Application

$$V_{wm} \text{ (gal)} = (W_{wf}) / (50 \text{ lbs mulch} / 100 \text{ gal water})$$

Area of Coverage

$$A \text{ (acre)} = (W_{wf} / R_{wf})$$
$$A \text{ (ft}^2\text{)} = (W_{wf} / R_{wf}) * (43,560 \text{ ft}^2\text{/acre)}$$

Where:

Wood fiber application rate (lb/acre)	R_{wf}
Weight or mass of wood fiber (lbs)	W_{wf}
Average water requirement (gal)	V_{wa}
Maximum water requirement (gal)	V_{wm}
Area of coverage (ft ²) & (acres)	A

APPENDIX E
Costs & Suppliers

This table provides estimated cost ranges for selected erosion prevention and sediment control BMPs, and their relative effectiveness for convenience of the user. The costs cited are estimates based on typical costs at the time of this writing and are not meant to be exact.

Installed Costs & Effectiveness of Erosion/Sediment Control BMPs

Erosion Prevention and Sediment Control BMP	Unit Cost Installed	Estimated Effectiveness (%) ¹
Sediment Control		
Sediment Fence	\$1.50 – 2.00 per lineal foot	95
Compost Berm (12-16 inch height)	\$1.75 – 2.00 per lineal foot	95 – 99
Fiber Rolls (9 inch)	\$1.50 – 2.00 per lineal foot	58
(12 inch)	\$2.00 – 2.50 per lineal foot	95 – 99
(9 inch with trackwalking)	\$3.00 – 4.00 per lineal foot	84
Erosion Prevention Controls		
Fertilizer	\$450 – 550 per acre	N/A
Seeding	\$870 – 2,170 per acre	50
Stolonizing	\$2,200 per acre + cost of stolons	90
Hydraulic Mulching	\$900 – 1,200 per acre	50 – 60
Compost Application (2,000 lbs/acre)	\$900 – 1,200 per acre	40 – 50
(2 inch blanket application)	\$7,000 – 10,000 per acre	95 – 99
(3-4 inch blanket application)	\$10,000 – 15,000 per acre	95 – 99
Straw Mulching	\$1,800 – 2,100 per acre	90 – 95
Soil Binders		
Plant Material-Based (Short-Term)	\$700 – 900 per acre	85 – 99
Plant Material-Based (Long-Term)	\$1,200 – 1,500 per acre	60 – 65
Polymeric Emulsion Blends (Including PAM)	\$700 – 1,500 per acre	30 – 95
Petroleum Resin-Based	\$1,200 – 1,500 per acre	25 – 40
Cementitious Binder-Based	\$800 – 1,200 per acre	80 – 85
Hydraulic Matrices (Wood mulch + Soil binder)	\$1,000 – 2,000 per acre	65 – 99
Bonded Fiber Matrices	\$5,000 – 6,500 per acre	90 – 99
Rolled Erosion Control Products		
Biodegradable		
Jute	\$6,000 – 7,000 per acre	65 – 70
Curled Wood Fiber	\$8,000 – 10,500 per acre	90 – 99
Straw	\$8,000 – 10,500 per acre	90 – 99
Wood Fiber	\$8,000 – 10,500 per acre	90 – 99
Coconut Fiber	\$13,000 – 14,000 per acre	90 – 99
Coconut Fiber Net	\$30,000 – 33,000 per acre	90 – 99
Straw Coconut	\$10,000 – 12,000 per acre	90 – 99
Non-Biodegradable		
Plastic Netting	\$2,000 – 2,200 per acre	< 50
Plastic Mesh	\$3,000 – 3,500 per acre	75 – 80
Synthetic Fiber w/Netting	\$34,000 – 40,000 per acre	90 – 99
Bonded Synthetic Fibers	\$45,000 – 55,000 per acre	90 – 99
Combination Synthetic and Biodegradable Fibers	\$30,000 – 36,000 per acre	85 – 99

Source: Erosion Control Pilot Study Report, Caltrans, June 2000, Table 4-1; Updated May 2004

¹ Effectiveness is based on the percentage of sediment retained by weight in laboratory tests. A high effectiveness rating may not equate to meeting water quality standards because some controls such as sediment fence retain larger particles and allow fines to pass which remain in suspension.

The following vendor lists are for public information and convenience of the user. Mention of company names is not an endorsement by the City of Gresham.

Material Suppliers

ACF West, Inc.
8951 SE 76 Drive
Portland, OR 97206
(503) 771-5115
(800) 878-5115

C.S.I.
3500 SE Columbia
Bldg 44-100
Vancouver, WA 98661
(800) 426-7976

Layfield Plastics
3890 Hammer Drive
Bellingham, WA 98226
(800) 796-6868

Oregon Culvert Company
10780 SW Tualatin-Sherwood Rd
Tualatin, OR 97062
(503) 692-0401

Northwest Linings & Geotextile
Products, Inc.
21000 77th Ave, South
Kent, WA 98032
(206) 872-0244

Contech Construction Products
710 SW Armco Ave
Hillsboro, OR 97123
(503) 648-4123

Lakeside Reclamation
14930 SW VanDermost Road
Beaverton, OR 97007
(503) 628-1866

Emerald Seed & Supply
9330 NE Halsey St
Portland, OR 97220
(503) 254-8414

Rexius Forest By-Products, Inc.
17550 SW 63rd
Lake Oswego, OR 97035
(503) 635-5865

Bark Blowers, Inc.
PO Box 512
Beaverton, OR 97075
(503) 248-2275

Best Mix Concrete Supply
3150 SE TV Hwy
Hillsboro, OR 97123
(503) 648-3100

Coconut Palm Resources, Inc.
2459 SE TV Hwy
Hillsboro, OR 97123
(503) 649-8101

Native Plant and Seed Suppliers

Bosk Dell Natives
23311 SW Bosky Dell
West Linn, OR 97068
(503) 638-5945

Hobbs & Hopkins, Ltd.
1712 SE Ankeny
Portland, OR 97214
(503) 239-7518

Granite Seed
1697 W 211 North
Lehi, UT 84043
(801) 768-4422

Hughes Water Gardens
25289 SW Stafford Road
Tualatin, OR 97062
(503) 638-1709

Quail Ridge Nursery
33689 S Ball Road
Molalla, OR 97038
(503) 829-3106

Samuel J Rich Nursery
9803 Yergen Road
Aurora, OR 97002
(503) 678-2828

Serendipity Nursery
8400 S Sconce Road
Canby, OR 97013
(503) 651-2122

Willowell Nursery
8160 SW Landau St
Tigard, OR 97223
(503) 768-5976

Emerald Seed & Supply
9330 NE Halsey St
Portland, OR 97220
(503) 254-8414
[Seed only]

Erosion Prevention and Sediment Control Installers

Krueger's Associated Landscape
& Supply, Inc.
PO Box 32
North Plains, OR 98037
(503) 647-1000

Kwik-Way Erosion Control
18860 S Pear Road
Oregon City, OR 97045
(503) 631-3204

Metropolitan Landscape, Inc.
PO Box 000
Beaverton, OR 97075
(503) 642-5684

Anderson's Erosion Control
PO Box 205
Junction City, OR 97448
(503) 998-2062

Northwest Hydro-Mulchers, Inc.
37621 SE Bearcreek Ln
Boring, OR 97015
(503) 668-5531

Erosion Control Services, Inc.
29895 SW Kinsman Road
Wilsonville, OR 97070
(503) 682-3211

Verchan Environmental Const.
14314 SW Allen Blvd # 122
Beaverton, OR 97005
(503) 626-1122

Erosion Control Northwest, Inc.
22821 Boones Ferry Rd, NE.
Aurora, OR 97002
(503) 678-7990

Dave Jossi & Sons
10490 NW Gravelland Road
Hillsboro, OR 97124
(503) 647-5641

W.E. Dotzenrod Construction
PO Box 5395
Aloha, OR 97006
(503) 222-0561

Ben Fox, Inc.
7028 SE Renada St
Milwaukie, OR 97267
(503) 654-8816

Erosion Control Contractors of Oregon
2077 Kindle Way
Stayton, OR 97383
(503) 580-7417

Dean Petshow Construction
471 Willomina Ave
Forest Grove, OR 97116
(503) 359-9453
(503) 267-8114

Street Sweeping

Mid-State
PO Box 926
Sherwood, OR 97140
(503) 625-0596

All Vac (catch basins)
10121 N Oregonian Ave
Portland, OR 97203
(503) 289-4063

Portland Sweeping Service
(503) 222-2262

Coast Services
PO Box 23697
Tigard, OR 97281
(503) 227-4515

Tracy's Sweeping
(503) 631-7911

Western Pacific
PO Box 4618
Vancouver, WA 98662
(503) 646-0103

Pavement Maintenance, Inc.
(503) 655-1170

Green Waste Disposal & Compost Suppliers

Yard debris compost is produced commercially by several local processors. It is made from yard wastes such as grass clippings, leaves, and branches. It can be used as top dressing, mulch, soil amendment, and erosion control.

The following list is provided for convenience only. Processors may sell their compost in bulk at their locations; some deliver it to Gresham locations. The listing of companies below are not endorsements by the City of Gresham.

Metro Regional Services regulates green waste processing facilities in this area. Additional information can be found at www.metroregion.org or by calling 503-234-3000.

All Wood Recyclers
223rd and Marine Dr
Fairview, OR 97024
(503) 667-5497

Circle S Landscaping
22420 NE Halsey
Fairview, OR
503-667-6820

Grimm's Fuel Company
18850 SW Cipole Rd
Tualatin, OR 97062
503-636-3623

Northwest Wood & Fiber
11005 NE Marx Street
Portland, OR
503-252-2614

Wood Waste Management
7315 NE 47th Ave
Portland, OR
503-493-3370

American Compost & Recycling
9707 N Columbia Blvd
Portland, OR
(503) 286-0886

East County Recycling
12409 NE San Rafael
Portland, OR
503-253-0867

McFarlane's Bark
13345 SE Johnson Rd.
Milwaukie, OR 97222
(503) 659-4240

S & H Logging
20200 SW Stafford Rd
Tualatin, OR 97062
(503) 638-1011

APPENDIX F

Sources of Information and References

Sources of Information for Preparing Erosion Prevention and Sediment Control Plans

Organization	URL
City of Gresham Stormwater Division	www.ci.gresham.or.us/departments/des/stormwater/
Oregon Seed Certification Service	www.oscs.orst.edu
Natural Resource Conservation Service	www.or.nrcs.usda.gov
International Erosion Control Association (IECA)	www.ieca.org
IECA Pacific Northwest Chapter	www.pnwieca.org
West Coast Weather Observations	www.ocs.orst.noaa.gov
Oregon Coast and Pacific NW Weather	IWIN.nws.noaa.gov/iwin/or/or.html
Oregon Department of State Lands	statelands.dsl.state.or.us
Oregon Department of Fish and Wildlife	www.dfw.state.or.us
Oregon Department of Environmental Quality	http://www.deq.state.or.us/wq/
Oregon Department of Agriculture	www.oda.state.or.us/oda.html
US Geological Survey	www.usgs.gov
US Army Corps of Engineers-Portland District	www.nwp.usace.army.mil/op/g/home.asp
NOAA National Weather Service	www.wrh.noaa.gov

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- American Association of State Highway and Transportation Officials (AASHTO). 2003. Standard Specifications for Compost for Erosion/Sediment Control (Compost Blankets MP-10). AASHTO, Washington, DC.
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